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Edited by H. H. Brown, A. M. Inst. N. A.
Member Soc. N. A. and M. E.

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American Shipbuilders Making Good

WITH the launching of 123 merchant vessels of 631,944 deadweight tons in July—more than have been launched from American shipyards in any previous twelve months—American shipbuilders are making good. In response to a message from the chairman of the Shipping Board giving details of some of the recent accomplishments in American yards, General Pershing cabled, "The news thrills every American in France. Well done!"

In July, American shipyards completed 41 merchant vessels of 235,025 deadweight tons. From August, 1917, when the present Shipping Board began operations, up to August 1 of this year, there has been completed and placed in service 247 ships aggregating 1,571,856 deadweight tons. Almost half of this tonnage was delivered during the last three months, the actual amount being 775,545 tons. Up to August 24, when the last figures were available, 535 merchant vessels of 2,923,973 deadweight tons had been launched from American shipyards as a part of the Government shipbuilding programme, and 281 vessels of 1,725,731 tons has been delivered.

An Epoch-Making Launching

IN ordinary times the launching of a 7,500-ton steel steamship would be an event too commonplace to call for special comment, but to appreciate the real significance of the launching of the first ship of this size at Hog Island last month it is well to ponder the comments of such men as the Chairman of the Shipping Board, the Director General of the Emergency Fleet Corporation and the head of the company that is building the ship, which, in part, were as follows:

"The launching of the *Quistconck* marks the beginning of an epoch in the nation's history. The men who have worked on this ship, and those who are working on other ships for the Emergency Fleet Corporation, are the makers of a new America. Through the efforts of the shipyard workers, a large American army is now in France, and through their continuous work this army, steadily growing larger and larger, eventually will overwhelm the carefully constructed military programme with which Germany has planned to dominate the world."—*Edward N. Hurley, Chairman, United States Shipping Board.*

"Never before has there been such a big demonstration at any launching in the United States. It is probable that there never will be another, but the enthusiasm shown here will never die. The launching of the *Quistconck* brings to a successful completion the first unit which will be turned out through American workmanship and ingenuity at the world's greatest shipyard."—*Charles M. Schwab, Director General, United States Shipping Board Emergency Fleet Corporation.*

"The launching of the *Quistconck* marks the passing of Hog Island from a constructive undertaking to a manufacturing plant, to be operated at its full capacity for the manufacture of ships. From now on, as long as our country may require it, ships will be manufactured in quantities.—*Charles A. Stone, Chairman, Board of Directors, American International Shipbuilding Corporation.*

Pennant Winners

THE Hog Island yard was not alone in gathering in honors last month, however, for the Merchant Shipbuilding Corporation at Harriman, Pa., also launched its first vessel, and now all of the great government yards established for the assembling of fabricated steel ships have reached the stage of schedule production, which will greatly increase the output of American shipyards during the coming months. That startling results are assured is shown by the patriotic enthusiasm with which every shipyard in the United States is striving to secure the coveted privilege of flying the pennant flags awarded by the Shipping Board for the best monthly record in production. In both May and June the honors went to the Pacific Coast, but this result has only stimulated shipbuilders in other parts of the country to put forth every effort to beat the splendid records of their friendly competitors on the Pacific Coast. For June, the awards were as follows: (steel ships) first pennant, Skinner & Eddy Shipbuilding Corporation, Seattle, Wash.; second pennant, Bethlehem Shipbuilding Corporation (Union plant), San Francisco, Cal.; third pennant, Columbia Shipbuilding Company, Portland, Ore.; (wood ships) first pennant, Grant, Smith, Porter Ship Company, Aberdeen, Wash.; second pennant, Smith, Grant, Porter Ship Company, St. Johns, Portland, Ore.; third pennant, White, Seaborn Shipyards Company, Tacoma, Wash.

Steel Requirements

AT a recent meeting of the War Industries Board the question of government steel requirements was thoroughly discussed, with a view to meeting, if possible, every actual demand for steel for war purposes. The largest of the government steel requirements are, first, for the railroads; second, for the shipbuilders; third, for the War Department, and fourth, for the Navy. The question of supplying these demands so effectively that there need be no curtailment of actual war activities was put squarely before the steel makers and all others concerned in any way with steel production. As a result of this conference, it was decided that there must be: First, greater conversion of mills to the production of steel required in the war programme; second, an increase in the supply of coal, particularly by-products coal, available for mills engaged in war work; third, the shutting off of further steel shipments to industries other than those engaged in meeting war needs, and fourth, more rigorous conservation in the handling of steel in the mills.

It is a pleasure to record that the steel men not only promised to co-operate to their utmost in meeting the government needs, but virtually pledged themselves so to in-

crease their output as to guarantee the requirements of the war programme. Notwithstanding this praiseworthy attitude, there still remains the fact that new needs at the battlefront in France have added to the gap between capacity and requirements in the steel industry. According to the *Iron Age,* the requirements for the last four months of the present year will bring the total for the second half of the year up to 23,000,000 tons, as against an estimate of 20,000,000 tons early in June and a probable production of from 17,000,000 to 18,000,000 tons for the six months. It is to be hoped that with a better understanding of the specific needs the shipbuilders at least will not be handicapped by lack of ship materials or serious delays in delivery.

Motorships Coming Into Their Own

BY awarding contracts for the construction of thirty-six steel, twin-screw, Diesel-engined motorships of about 5,000 tons deadweight carrying capacity each, the Emergency Fleet Corporation has given a decided impetus to the motorship and marine oil engine industries in this country. The hulls of these vessels will be of special design, the material for which will be fabricated in structural steel shops and erected in shipyards on the Atlantic and Pacific coasts. The vessels will be 334 feet 9 inches long over all, 333 feet between perpendiculars, 46 feet beam, 29 feet 9 inches molded depth, and at a draft of 21 feet will have a displacement of about 7,100 tons. With a total shaft horsepower of 1,500, developed on two shafts, the vessels will have a speed of from 10 to 10½ knots.

In twenty-six of the vessels ordered, the main propelling machinery will consist of McIntosh & Seymour, six-cylinder, Polar, trunk piston Diesel engines, with cylinders 22 inches diameter and 32 inches stroke, designed to operate at 130 revolutions per minute. Each engine will weigh about 100 tons and will develop about 750 shaft horsepower. In ten of the vessels the main propelling machinery will consist of two six-cylinder, Skandia-built, Werkspoor Diesel engines, with cylinders 20½ inches diameter by 35½ inches stroke. These engines will develop the same power and run at about the same speed as the others, but will weigh only about 96 tons. Both types of engines are single-acting, direct reversible, of the four-cycle type, but the Werkspoor engines are built in accordance with steam practice with crossheads and guides. All the auxiliaries will be electrically driven, current being supplied by Diesel-engined generating sets.

Some of the ships of this type, it is understood, will be fitted with steam propelling machinery, so as to give an opportunity for direct comparison of the two methods of propulsion. With the motor installation it is estimated that the daily consumption of fuel will amount to about 6½ tons. As each vessel will have a total fuel capacity of 976 tons, with provision for carrying an additional supply if necessary, the motorships will have a possible cruising radius of about 40,000 miles.

This initial Government order for motorships will be welcomed by American shipowners, as eventually it will furnish some badly needed information regarding the reliability of American-built marine Diesel engines and will tend to substantiate or disprove the claims of manufacturers of this type of propelling machinery. No one disputes the theoretical thermal efficiency of the Diesel engine or its possible savings in fuel consumption, but the limited experience which American shipowners have so far had with such engines designed for cargo vessels has failed to justify a feeling of confidence in their reliable performance under all conditions of sea service and the consequent overall economy of such installations. If the design or workmanship of the engines is at fault in any way, the trouble will be manifest in poor efficiency or breakdowns, and in such cases the time lost and expense of repairs, readjustments and replacements will soon offset the theoretical gains. Proper installation and skillful operation are essential for success in Diesel-engined vessels, and we sincerely hope that no precaution will be overlooked to make these first government motorships give a good account of themselves. If the motorship advocates' claims are sustained in this case, a bright future is in store not only for American oil engine builders but more especially for American shipowners, to whom the principal advantages will accrue.

Status of the Concrete Ship Programme

NUMEROUS articles regarding the design and construction of reinforced concrete ships have been published in recent issues of MARINE ENGINEERING to show what has been accomplished in this new branch of shipbuilding, both in the United States and abroad. That concrete shipbuilding will find a limited field of usefulness in the present emergency seems assured, but its future as a competitor of the steel shipbuilding industry is confronted with too many obstacles and uncertainties to warrant its extended adoption at the present time. In the first place data are lacking regarding the behavior of a concrete steam or motor ship in ocean service, except for vessels of small size, and that is too limited to form a secure basis for future assumptions. For vessels of large size the concrete ship is handicapped by greater weight and the uncertainty of the effect of the stresses encountered at sea on the various forms of construction proposed. Estimates of cost are also based upon assumptions as yet not borne out by practice. But in the United States, at least, the status of the concrete shipbuilding industry is dependent upon other factors outside of the question of the construction of the hull itself, which apparently have been overlooked or misunderstood by the concrete ship advocates, who, for the most part, are not experienced shipbuilders. The situation has been clearly explained by both the Director General and the General Manager of the Emergency Fleet Corporation.

Mr. Schwab rightly says that small ships are not economical for trans-oceanic service and that for large vessels we must rely upon steel. Until we have built some 7,500-ton concrete ships, which we are doing to-day, and tried them out, we would not be justified in diverting energy, material and labor from what we are sure of. Besides, at the present time our principal trouble is in getting fittings, which also would be required for concrete ships, and added construction in this field would only accentuate these difficulties.

Mr. Piez further points out that to-day the hull-producing capacity of the country in steel and wood ships is in excess of what may be termed the power and equipment-producing capacity for fitting out ships. Furthermore, as a carrier, the steel ship is admittedly from 15 to 20 percent more effective than a wood or concrete ship of similar tonnage. Although the output of steel and wood ships is constantly increasing, we have not yet reached anything like the possibilities of output in steel construction. It should be remembered that in the building of a ship of any type, only 60 percent of the total labor is connected with the hull and that fully 40 percent of the total labor input, and that the most highly skilled and the most difficult to obtain, is connected with the installation of machinery and equipment.

Until the concrete ship advocates are prepared to build and install the machinery and fittings as well as the hull, it would appear that their efforts to supplement the steel ship programme are misdirected.

American Ships for Foreign Trade

Great Merchant Fleet Will Open New Opportunities for Manufacturers in Foreign Trade—Stirring Appeal to Business Men

BY EDWARD N. HURLEY*

WITH something like 25,000,000 tons of merchant shipping to be employed inside of two years, the United States Shipping Board feels that it is none too early to look around for cargoes, both in this country and abroad. With the task of building the ships in charge of the Emergency Fleet Corporation, under the leadership of Charles M. Schwab, this function of the United States Shipping Board begins to attain prominence—and that is what the Shipping Board was originally created for by Congress.

Shipping Available in Two Years

Twenty-five million tons is a lot of shipping. In one voyage these ships would carry all the live stock, dressed meats, packing-house products, poultry, game, fish, wool, hides and leather carried on our railroads in one year. In less than five trips they would carry our whole yearly railroad haul of grain, flour, cotton, hay, fruit, vegetables and other farm products; in three and one-half trips all our lumber; in seven trips all our manufactured goods; in sixteen trips all our coal and coke. The total tonnage hauled on our railroads is about 1,200,000,000 tons.

So, amid all his splendid effort in producing equipment to win the war, the American manufacturer must be asked to take thought for to-morrow and think in terms of shipping and foreign trade. This might appear like a distraction now—something which will take the attention from the supreme duty of winning the war. But far from being a distraction, it fits in with war production and war psychology. While our factories and factory employees are building war material to-day, they are also building foreign trade, if we can only see things whole and make one factor work with another.

When the business man turns his attention to export trade he looks abroad and thinks of foreign customers. But foreign trade actually begins in his own factory. He looks abroad and studies such factors as ocean freights, foreign exchange, export packing and international salesmanship. If he would look into his own factory first and study factors close at hand, such as labor turnover, wages, manufacturing costs and efficiency, he would be laying solid foundations for export trade.

Manufacturing "Effectiveness"

In a recent study of factors that make successful, lasting foreign trade, Professor Taussig places first of all the element of manufacturing "effectiveness," as he calls it, which he defines as a combination of capital, labor, invention, salesmanship and transportation, all working together under first-rate business leadership, to make goods capable of holding markets in competition with the products of other nations. These elements of effectiveness are largely right at hand in our factories—it is not necessary to send anybody abroad to find them. And as an illustration of how nations make mistakes in trying to build foreign trade at the other end, Professor Taussig shows that real effectiveness in manufacturing almost invariably holds its own against artificial devices for building foreign trade, such as export bounties, special railroad rates on export shipments, cut prices, discriminatory tariffs, etc.

With the bugaboo of cheap foreign labor haunting us in former years, we got into the way of thinking that export trade necessitated some lowering of wages and American living standards. Probably that was crooked thinking before the war. Certainly it is crooked thinking now, for the war is bringing other nations closer to our American standards of wages and living.

True development of foreign trade in our factories means better and better American standards.

In most of the countries of the world there will be a decided shortage of labor after the war. That country will best succeed which protects its workmen by improving their living conditions, guaranteeing a fair return for labor, protecting workmen and their families against accidents and idleness, and making workers better citizens. The country taking those measures will be the country that develops and makes products most economically, and will perform a world service by making goods at the prices fair to other nations.

Mobilizing Man Power for Foreign Trade

Nobody has yet suggested sending cheap American soldiers over to France to win the war. Our men at arms are the pick of the country, physically and mentally. We take plenty of time to train them, make them specialists in every branch of fighting. We study them individually to find which are best suited for flying, or signalling, or bombing, or bayonet fighting. We recognize that modern war is a swift game, constantly changing, and that our soldiers must be prepared to learn new trades and new tricks from month to month, and we get ready to teach them these new trades and also put them in a receptive attitude toward improvements in the fighting game. We feed them like fighting cocks and spare no expense in clothing them or providing the latest fighting tools.

In the army and navy we have a visible mobilization of man power for results in a foreign country. If we could have the same visible mobilization of man power in our factories for foreign trade it would be a splendid object lesson for those who manage the factories and make the export goods.

To think of cheapness in connection with foreign trade is just as wrong as trying to pin bargain tags on soldiers. Foreign markets are not going to be won or held by cheapened American workers or bargain methods in American life. As manufacturers, we have got to lay the foundations for foreign trade by going out into our factories and studying labor and costs together. We can sell our export products at reasonable prices by increasing wages along with output and decreasing the losses caused by labor turnover, untrained workers, spoiled materials and other inefficiency.

Our experience along these lines in the Emergency Fleet Corporation has been most encouraging. With the task of creating new shipyards in a few months and manning them with several hundred thousand workmen, most

* Chairman, United States Shipping Board.

of whom came from other trades, we ran into about every difficulty, and problem, and tangle, that could conceivably arise in management. On a large scale we effected an adjustment of man power such as is called for now in preparing the average American factory for the export trade which we will need to keep our ships employed.

Co-Operation with Workers

To get production at unheard-of speed and in record-breaking quantity, we did something simple and fundamental—and thoroughly human. This was nothing more nor less than arranging wages so that, while our workers produced more for us, they were also able to produce more for themselves. We established the rule that a piecework wage rate set by any shipbuilder must stay in force during the period of the war. Any manufacturer who sets a piecework rate and then reduces that rate if he finds that he has made a mistake against himself is doing a great injustice to his employees. Profiting by our experience in the shipyards, I should like to see Congress pass a Federal law making it compulsory to keep every piece rate in effect one year. That would protect workers and furnish a real basis for increased production.

Reducing Labor Turnover

We found ourselves confronted with enormous losses and dangerous delays through lack of skill by workers in special trades needed in the shipyards and also through the cost of labor turnover. To find 100 capable shipbuilders who would stick on the job, it was necessary to hire and try, discharge or lose 1,000. Every manufacturer will recognize in these difficulties exactly the difficulties that he himself faces from day to day, and which put excessive burdens of cost upon his products. In the shipyards we got around those difficulties by establishing training centers for the various trades we needed, and also by appealing to the splendid spirit which lies in the average worker. We had to train everybody, from the boy who heats rivets right up—foremen and superintendents, and even executives. Starting with a little nucleus of skilled riveters, calkers, reamers, carpenters and so forth, we took them out of the shipyard for a time and taught them how to teach their trades to others. Then they went back into the yards to teach green recruits, not in any school or class, but on actual ships, while doing the regular day's work. Under this system it was possible quickly to bring green gangs up to about 80 percent of the efficiency of skilled workmen. As fast as these men learned their trades and acquired high earning power under our protected piece rates, they became steady enough, and the costly item of labor turnover began to drop. After that nothing more was needed but the appeal for patriotic service. We found that the shipworkers would not only stick on the job like soldiers, but that in their inherent spirit as fighters and loyal Americans there was an enormous reserve of man power to draw upon—a reserve capable of meeting every demand and every emergency, with power to spare.

Wake Up, American Business Men!

That reserve of spirit exists in every American industry. War has brought it to light where executives can see it, and to develop this great reserve for foreign trade is distinctly the executive's job.

To fill our merchant ships with goods after the war and hold our own in foreign markets, we must begin now to mobilize and train our man power in manufacturing along the same broad lines followed in training for military purposes. Wake up, American business men! Begin to study the man power in your own organizations—not with the Prussian viewpoint, which counts human life its cheapest raw material in both the factory and the fighting line, but with the American viewpoint of decent living, opportunity, humanity, service.

Magnitude in Present-Day Construction Work

SIZE and speed distinguish most of the present-day undertakings in the construction field. Contracting firms that four years ago would have looked upon a million-dollar contract as large are to-day as readily undertaking work that runs up into the tens of millions, are handling men by the thousand and material in heretofore unheard-of quantities.

The following authentic figures regarding the largest destroyer plant in the world at Squantum, Mass., are, therefore, of peculiar interest. This plant, built by the Aberthaw Construction Company, of Boston, for the Bethlehem Shipbuilding Corporation, Ltd., was started in October of last year and the work carried through to completion during one of the most severe winters that New England has ever known.

The site when the builders started work consisted of a marsh with a few areas of upland here and there that were slightly above high-tide level. In order to make land on which to build buildings, one and one-quarter million cubic yards of filling had to be deposited upon the land. About two-thirds of this quantity was dredged up from the harbor by the dredges which were forming the launching basin and channel that connects with the main ship channel. The remainder of the material was dug by steam shovels in various adjoining gravel pits. In order to move this amount of material a travel of 140,000 car miles was recorded.

Five thousand freight cars full of building material were brought to the job. An idea of the amount of this material can be gained if it is remembered that these cars placed end to end would reach from Boston to Worcester, and that in addition 50,000 truck loads and teamloads of material of various kinds were brought over the road.

Most of the buildings are built upon piles, about half a million lineal feet of wood and concrete piling being driven. The steel framing of the buildings called for 11,000 tons. The area of the roofs of the buildings amounts to 30 acres, and the perimeter of them is just under three miles. There are twelve acres of window glass in the job, requiring 110 tons of putty to fasten it in place. Six miles of standard gage railroad track were laid around the building and in connecting the plant to the New York, New Haven & Hartford main line.

The wood roofs, wharves, docks and temporary buildings called for a total of 10,000,000 board feet of lumber, the bulk of which was cut in the South. Thirty miles of piping were needed in order to take care of the needs of water and sewerage, steam, compressed air, fuel oil, sprinkler lines and fire mains, and 16,000 sprinkler heads to protect the buildings from fire. Eight thousand gallons of paint were needed for windows, steel and woodwork.

For carrying through the great undertaking the Aberthaw Construction Company added quickly to its permanent organization enough men to make up a total of nearly 6,000. They have now under way for the same clients a far larger undertaking on the Pacific coast that may eventually call for the work of 20,000 men.

Manning the New Merchant Marine

Free Schools Established for Training Deck and Engine Room Crews for American Ships—Details of the System Explained

BY HENRY HOWARD*

PRESENT construction plans for our merchant marine call for more than 14,000,000 tons of new shipping, to be completed within two years.

At the beginning of the world war, in August, 1914, seven nations were credited with more than 1,000,000 tons of shipping each. Great Britain headed the list with 19,799,119 tons; the United States stood next with 7,928,688 tons, and Germany third with 4,892,416 tons, the other nations standing: France, 2,173,544; Norway, 2,425,476; Sweden, 1,114,048, and Japan, 1,167,264. Austria had less than 1,000,000 tons, with 988,130. Of the tonnage of the United States, something more than 2,000,000 tons was available for deep-water service in the Atlantic.

The first year of the war was sufficient to show the United States that the process of attrition in the world's supply of tonnage was creating a shortage of ships. This shortage became acute when the United States entered the war, thereby adding to this country's vast needs of sea transportation of troops and supplies, and the quickened need of sending more and yet more supplies to our Allies. Indeed, steps had been taken for developing our merchant fleets some months before with the creation of the United States Shipping Board, by Act of Congress in September, 1916. Accordingly, when the United States entered the war it was ready to exercise its functions as sponsor for a new, nationalized merchant marine. Immediately the country had become a party to the war, suggestions poured in on the Shipping Board as to ways and means of adding largely and rapidly to the nation's tonnage in merchant ships.

Organization of the Training System

Coincident with the sudden awakening of the nation to the vital need for more cargo ships, and the energetic initial steps of the Shipping Board to produce them, came forward the important question of manning the new merchant marine so soon to come into being. The country as a whole was unaccustomed, in recent times, to thinking in terms of shipping and appeared doubtful of its ability to produce the mariners needed to handle its new fleets. We were no longer a sea-going people, said the doubtful; we had lost the art of the sailor when the American square-rigged ship went out of use as a leader among the world's cargo carriers. Surely, our war need was pressing enough to appeal to the patriotism of Americans with a liking for the sea, but would any considerable numbers come forward for service on merchant ships?

Relatively few men who had a knowledge of maritime affairs and a broad view of the trend of events in the world war were able to grasp both the needs of the hour and the means of meeting them—to take an optimistic view of our country's ability effectively to turn back to the sea, where it won its first laurels in commerce. Such men there were, however, in the United States Shipping Board when that body was approached with a plan for manning our new merchant fleets.

The plan provided, in brief, for a training system to prepare Americans for service on American merchant ships, the work to begin with the training of officers and eventually to extend to the training of crews. Among the many thousand fishermen on our coasts—not less than 100,000 on the Atlantic and Gulf seaboards alone—could be found excellent material for merchant officers and sailors. Furthermore, former sailors were to be found in almost all the states, engaged in various occupations—former captains, mates of sailing vessels, and not a few former officers of merchant steamers. Many marine engineers working ashore and other engineers could also be prepared in a short course of special training for service at sea.

Free Schools Established

By establishing free schools in navigation at important ports, and free classes in marine engineering at some of the leading technical colleges, it was proposed to train enough men of the types indicated to meet the forthcoming increased demand for American deck and engine-room officers for the new American cargo ships.

On May 29, 1917, the writer was authorized by the Shipping Board to inaugurate the training plan, and on June 1 was sworn in as Director of Recruiting Service for the Board. Three days later the first free navigation school to be conducted under the direction of the United States Shipping Board was opened, with twenty students, at the students' astronomical laboratory, Harvard University. Later this school was transferred to the Massachusetts Institute of Technology, where it has since been maintained.

The work of organizing additional schools went on through succeeding months, until forty-one in all were established on the Atlantic, Gulf and Pacific coasts and the Great Lakes. The response of men qualified to enter the schools was quick and gratifying. Many patriotic applicants expressed a willingness to leave lucrative positions ashore in order to fit themselves for service in the merchant marine in war time; others frankly hailed with delight an opportunity to get back to the sea, which they had left because of unpromising conditions in the decade preceding the opening of the Great War.

National Headquarters at Boston

National headquarters of the new training service were established at Boston. For administrative purposes in establishing and maintaining the schools, the country was divided into sections, following closely the geographical divisions employed by the United States Steamboat Inspection Service, which from the first co-operated heartily with the Recruiting Service of the Shipping Board in maintaining the standard set by the regulations of the Department of Commerce. The Board was fortunate in securing as section chiefs men of professional or business training, whose patriotism led them to donate their time to this service. The section chiefs of the service are as follows: Section I, Mr. Horatio Hathaway, Jr., twelfth floor, Custom House, Boston, Mass.; Section II, Mr. John F. Lewis, 108 South Fourth street, Philadelphia, Pa.; Section III, Mr. Hardy Croom, 130 Riverside avenue, Jacksonville, Fla.; Section IV, Mr. Ernest Lee Jahncke, 814

* Director of Recruiting Service, U. S. Shipping Board, Boston, Mass.

Howard avenue, New Orleans, La.; Section V, Mr. Farnham P. Griffiths, 465 California street, San Francisco, Cal.; Section VI, Mr. William J. Grambs, 860 Stuart building, Seattle, Wash.; Section VII, Capt. Irving L. Evans, 933 Guardian building, Cleveland, Ohio.

System of Instruction

Direction of instruction in the navigation schools was placed in the hands of Professor Alfred E. Burton, dean of the Massachusetts Institute of Technology, who formerly was connected with the Coast and Geodetic Survey, and who is a practical navigator of wide scientific knowledge. Professor Burton selected his instructors from among men of practical training, among them astronomers, explorers and former sea captains with recognized standing as teachers.

By the system of instruction perfected for the schools, comprising the most approved methods of teaching navigation, it was possible to impart to a student in a six-weeks' study a groundwork of the theory and practice of navigation to enable him to pass the examination of the United States Steamboat Inspection Service, entitling him to a license as a second or third mate. After passing the examination, the student in need of practical experience on a steamer was sent to sea in the capacity of a reserve officer, for a period of two months, to learn the ropes before actually assuming the full responsibilities of the position for which he was licensed.

Since the opening of the first school in navigation by the Recruiting Service of the Shipping Board, thirty-nine others have been opened.

The graduates from these schools, in the ten months from June 1, 1917, to April 1, 1918, numbered 1,500.

Engineering Schools

The training of engineers was placed in the hands of Professor Edward F. Miller, of the Massachusetts Institute of Technology, and classes were established at Massachusetts Institute of Technology, Stevens Institute of Technology, Bourse building (Philadelphia), Johns Hopkins University, Tulane University of Louisiana, Case Schools of Applied Science (Cleveland), Armour Institute of Technology, University of Washington.

The school at Stevens Institute of Technology was later discontinued and one was started at the Seamen's Church Institute in New York City.

The course in the engineering schools is of one month's duration. The qualifications for admission to these schools differ slightly from those required for admission to the navigation schools, as men with proper technical experience are admitted who may require as much as six months' added training at sea before becoming eligible for licenses.

About 1,200 marine engineers were graduated from the Shipping Board free engineering schools in the first ten months of their existence. Like the deck officers graduated, all were American citizens.

One noticeable effect of the Recruiting Service's call for Americans qualified to serve as officers in the new merchant marine was the stimulation given men qualified to take examinations for licenses, without special schooling. Not less than 3,600 original licenses were issued in that period—including those issued to the men specially trained by this service.

The Sea Service Bureau

The Sea Service Bureau was established as a necessary adjunct to the training service for officers. Graduates of the schools were placed on board ship by this department, at first entirely through the co-operation of private steamship interests, and later also on ships controlled directly by the Shipping Board. The work of this bureau showed at an early stage that without the supply of officers created by the Shipping Board schools there would have been at times in 1917 a shortage of mates and assistant engineers for American merchant ships, even before the Shipping Board's construction programme produced new vessels. Representatives of the Sea Serice Bureau established in various important ports exercised increasingly broadened functions in placing American officers and crews as the demand for them increased with the launching of increased numbers of merchant ships.

Training Merchant Crews

By the autumn of 1917 the construction programme of the United States Shipping Board, by which considerably more than 2,000 new ships will be commissioned under our flag, had advanced sufficiently to warrant the development of the second phase of the training plan—the training of crews.

Much thought was given by the Recruiting Service staff to working out a system of intensive training for crews by the use of a squadron of training ships. On December 12, 1917, announcement was made that the Recruiting Service was prepared to receive applications from young Americans between 21 and 30 who wished to be trained for service on merchant ships. In the three months following this announcement more than 7,500 applications were received.

The number of men required for this branch of the training service was at first estimated to be 85,000, but events subsequently led to a modification of this figure. At this time the need of arming all ships entering European waters with naval guns led to a proposal that all ships crossing the submarine zone be manned by the navy. After conferences on this point between officials of the Navy Department, the War Department—then operating the troop ships—and the Shipping Board, a decision was reached by which control of troop ships, animal transports and freighters carrying unbroken cargoes of munitions and supplies for military uses were placed in control of the navy, to be manned by naval crews, while Atlantic passenger liners, freighters with general cargoes for our Allies, and all merchantmen plying outside the war zone were left in the control of the Shipping Board. This arrangement imposed onto the Shipping Board the work of training many thousand young men for crews on these vessels. To administer the training service, a department was created termed the Sea Training Bureau, with a supervisor of training in charge.

Training Ships Provided

Two steel screw steamers were at once secured—the *Calvin Austin* and *Gov. Dingley,* twin ships, formerly in the passenger trade on the New England coast, each 3,800 tons gross register, 299 feet long and 60 feet wide, with reciprocating engines and 2,700 indicated horsepower. When converted into training ships, the vessels each had capacity for from 500 to 600 apprentices. While those two ships were being filled, a third, the former transport *Meade,* ex-*City of Berlin,* was being fitted out at Newport News. This was a graceful old Atlantic liner, with a sound hull and capacity for something more than 1,200 apprentices. Later a fourth ship, the *Gov. Cobb,* of the type of the two first named, was put into the training squadron, and plans were put on foot for placing a training ship on the Pacific Coast and another at New Orleans.

The training course is of an intensive character. There is an instructor to each ten apprentices, who is held responsible for the progress of his group. The apprentices virtually go to school all day, and every day, except Sunday, during their stay on the ship, which is not less than a month in any instance, and probably exceeds two months in a few cases. Daily routine begins at 6 A. M. with "All hands tidy room," and ends at 9 P. M. with "Turn out all lights." The recreation period from 6 to 9 P. M. includes singing of the old-time chanteys, in which the young men are instructed by a veteran deep-water chantey man.

When the apprentices have finished their intensive training they are added to regular crews in the merchant marine, on a given ratio to the experienced men carried. By this method it is expected that no difficulty will be experienced in securing full crews for all new ships added to the merchant fleet by the Shipping Board, as well as for any existing ships that may need men.

Port of New York Capable of Expansion

Present Volume of Overseas Commerce Through New York Can Be Doubled—Investigation by Port and Harbor Development Commission

THE port of New York can handle more than twice its present volume of business, according to the New York, New Jersey Port and Harbor Development Commission. Contrary to the impression created by last winter's congestion, the Commission officially announces that the studies and investigations already made demonstrate the fact that the capacity of this port for the handling of outgoing and incoming tonnage equals several times the present extraordinary war demands upon our port facilities.

This important official statement of the Commission appointed by Governor Whitman and Governor Edge last year and of which William R. Willcox, of New York, is chairman, and J. Spencer Smith, of New Jersey, vice-chairman, is based on the broadest and most searching and scientific survey and study of port facilities, of the operations and of the needs of the port of New York, that has ever been made.

The importance of the Commission's announcement is of particular significance, as it makes absurd the claim being made by interests located in other Atlantic seaports that the limit of New York's port facilities has been reached. The survey has disclosed the main causes leading to last winter's congestion, which is the basis of all reports alleging that the full capacity of the port of New York has been reached. These causes, Chairman Willcox declares, were due to abnormal weather conditions, lack of steamships, coal shortage and the absence of anything approaching co-ordination or co-operation in the tremendous shipment of raw materials toward the end of last year.

Chairman Willcox's Statement

Speaking for the Commission, Chairman Willcox said recently at the office of the Commission, 115 Broadway, that the port of New York has a water-front length of 770 miles, of which 320 miles have been developed. Of the 450 miles remaining for development, at least 50 miles are located in almost the exact center of this port.

"The Commission has already obtained," said Chairman Willcox, "through its experts and investigators in the field and in the records of the carriers, a large amount of data and information which clearly indicates that the port of New York, if properly developed, will be able to handle several times the amount of freight now entering and leaving the port.

"For the first time this Commission will have placed before it correct statements as to the present cost of passing commerce through this port.

"This information is fundamental, and it has never been known in the past what these costs were; until these costs are known it is impossible to make an economic proof of the necessities of additional facilities at the port and more scientific methods of conducting commerce.

"All of this work is being performed in the working office of the Commission located at 14 John street, New York City, which is under the direction of the consulting engineer of the Commission, B. F. Cresson, Jr.

"The problems presented by this port are more complex and involved and of vastly greater magnitude than those existing in any other seaport.

Nine Trunk Railroads Terminate in New York

"We have, for instance, nine trunk lines having separate terminals here. Our system of investigation requires that each of these be studied separately, and our groups of experts, statisticians and inspectors take up one unit after the other and secure first-hand and absolutely authentic records and make checks from the books of the respective railroad or corporation. One of our first steps was to have conferences with presidents and executive officers of the trunk lines and shipping interests using the port.

"We are investigating and resolving into maps, charts and records every other interest affecting port use or the use of its facilities. Our experts are studying truckage freight movements and the causes of delay in handling freight, and we have under way a survey to locate a belt line in New Jersey for the interchange of freight outside the congested Hudson River area. Other experts are at work on the electric power situation in New York; on the facilities for interchange of commerce on the New York Barge Canal; on barge canal terminals; locations for supplemental terminals; on coal bunkering and local coal deliveries. We will also take up inquiries into methods and regulations pertaining to pilotage, stevedoring, weighing, public and private ferries, sewerage disposal and the purification of harbor waters, the handling of building materials, the handling of grain, the disposal of municipal wastes, available warehouses, lighterage, markets, and the distribution of food products, ice, the methods of financing our commerce, and many other elements of the problem.

"The scope of our work comprehends every interest making use of the port. It is therefore national in its importance. I may say, in conclusion, we believe that the Federal government realizes and appreciates the wide range and practical aspects of our investigations."

Why is a "dollie bar" and where did it get its name? Speak up, somebody!

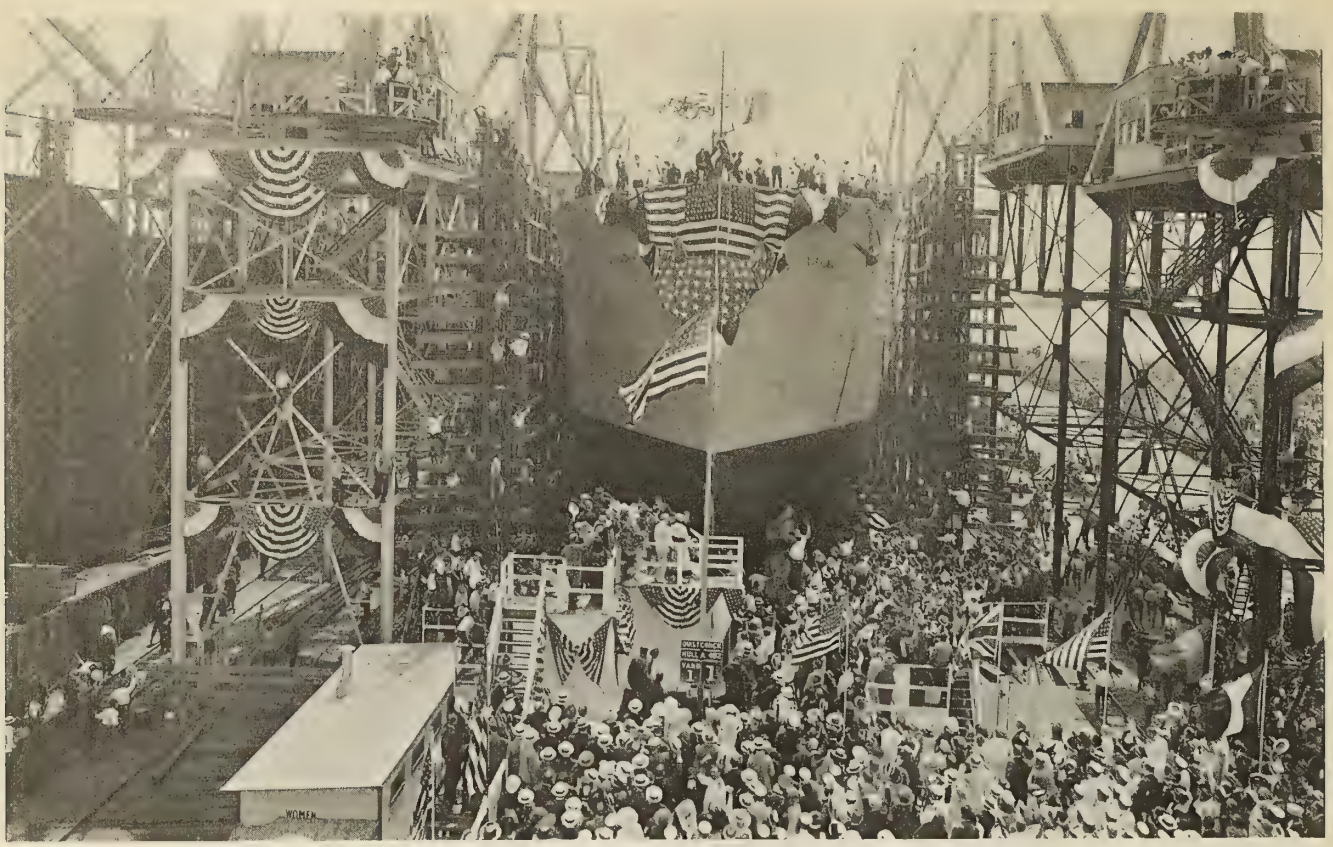


Fig. 1.—Launching the First Vessel at Hog Island

Fig. 2.—A Section of the Crowd that Witnessed the Launching of the *Quistconck* at Hog Island on August 5.

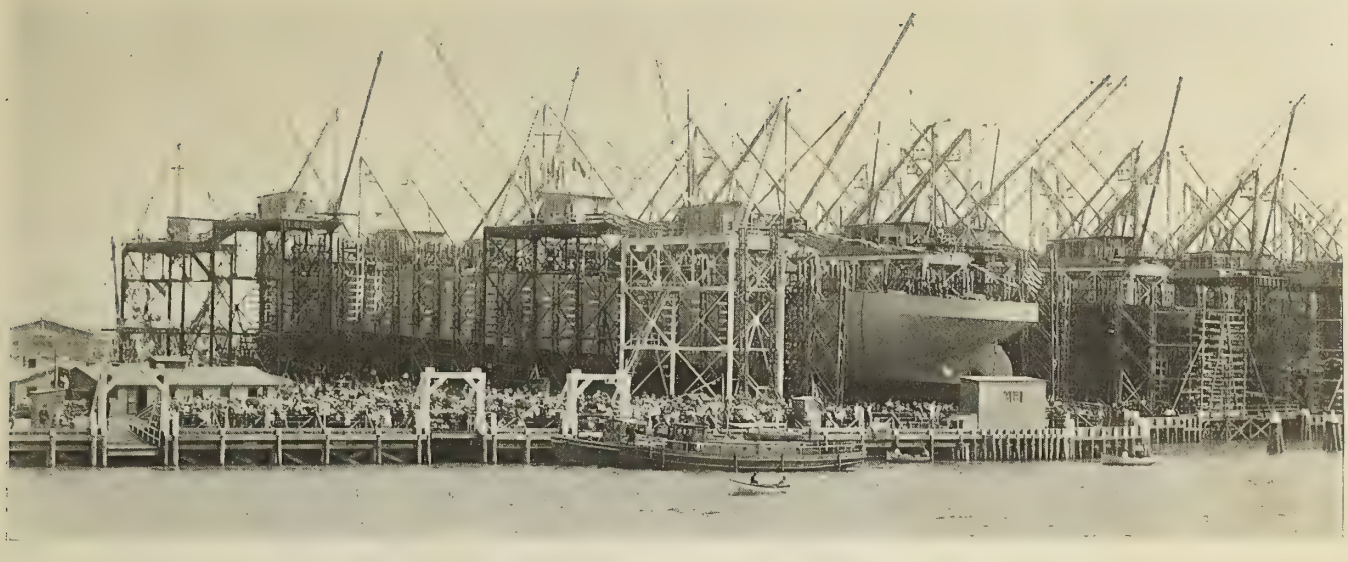


Fig. 3.—View of the *Quistconck* on the Ways Before Launching

Hog Island Yard Launches Its First Ship

Seventy-Five Hundred-Ton Deadweight Steamship Quistconck Launched on August 5—Christened by Mrs. Woodrow Wilson

THE launching of the first vessel at Hog Island on August 5 marked the beginning of actual production in the latest and the greatest of the government assembling plants, where fabricated steel cargo ships are being built for the Shipping Board. The vessel was christened *Quistconck* by Mrs. Woodrow Wilson in the presence of President Wilson, government officials, officers of the Shipping Board Emergency Fleet Corporation and many of the leading shipbuilders on the Atlantic Coast, together with over fifty thousand spectators.

The launching ceremony was impressive, not only because of its simplicity and dignity but also because of the business-like spirit which characterized the event. Less than half an hour sufficed to complete the official ceremony, and immediately following the launching the keel of another vessel was laid on the same shipway.

The Presidential party arrived at the yard on a special train from Washington at 12:30 P. M., and six minutes later the vessel was launched. The usual programme of speechmaking was entirely dispensed with, although a luncheon was served to the guests of the company at the head of the shipways.

The *Quistconck* is a single-screw, steel cargo vessel of the two-deck type, with bridge, forecastle and poop. The length over-all is about 401 feet, and the length at the load waterline 390 feet. The molded beam is 54 feet, the depth to the second deck 23 feet, and to the upper deck 32 feet. At full load displacement the draft is about 24 feet.

The vessel is designed for a deadweight capacity of 7,500 tons, the total displacement loaded being estimated at 11,200 tons. According to estimates the weight of the steel hull is 3,100 tons; of the machinery with water, 460 tons; of the wood and equipment, 140 tons, and the total weight of the ship, light, 3,700 tons. There are 380,000 cubic feet of cargo space and the gross tonnage is estimated at 5,400.

Propulsion is by single screw, driven by a geared turbine of 2,500 shaft horsepower, supplied with steam at 200 pounds per square inch pressure from three oil-fired watertube boilers, with a total heating surface of 9,075 square feet, operated under natural draft.

The main turbine is designed to operate at 3,600 revolutions per minute, driving the main propeller shaft through a double helical, double reduction gear at a speed

Fig. 4.—The First Lady of the Land Christens the *Quistconck*

of 90 revolutions per minute. With dry saturated steam at 180 pounds gage pressure at the throttle, a 28-inch vacuum referred to a 30-inch barometer in the condenser, the steam consumption of the turbine, when developing its rated horsepower, is guaranteed not to exceed 12 pounds per shaft horsepower. The vessel has a fuel capacity of about 1,100 tons, and, with an estimated fuel consumption of 29½ tons per twenty-four hours, will have a cruising radius of over 10,000 nautical miles.

At the Hog Island yard practically all of the fabrication of the hull is done in outside shops. The shipyard itself is operated merely as an assembling yard, with sufficient shops and equipment to rectify the fabricating work shipped into the yard which has been damaged, or for replacing parts that are needed. About 80 percent of the hull riveting is done in the yard, and only 20 percent in the fabricating shops.

The hull of the vessel is constructed on the transverse framing system and is subdivided into nine watertight compartments by eight transverse watertight bulkheads, all of which extend to the upper deck. There are four cargo holds, served by five hatches in the upper and second decks and one hatch in the bridge deck.

The original contract awarded to the American International Shipbuilding Corporation on September 13, 1917, called for the construction of a shipyard with fifty ways and the building of fifty 7,500-ton steel cargo steamers of 11½ knots speed. On October 23, 1917, a supplementary order, based on an option in the original contract, was signed for seventy 8,000-ton vessels of similar type, making a total of 120 vessels. On May 7, 1918, a still further order for sixty more 7,500-ton cargo vessels was signed, bringing the total up to 180. According to the terms of the contract the last of the 180 vessels is to be delivered complete by August, 1919. When the yard is in full operation it will have a capacity of 1,500,000 tons of shipping per year.

Fig. 5.—The *Quistconck* Entering the Water

Fig. 6.—First Product of Hog Island Yard Moored at Her Fitting Out Berth

The Most Suitable Sizes and Speeds for General Cargo Steamers*

Method of Determining Most Economical Dimensions of Cargo Vessels for Any Length of Voyage, Condition of Loading and Speed

BY JOHN ANDERSON

FROM correspondence which recently appeared in a British technical journal on the subject of the best size and speed of general cargo steamers, it appeared to the present writer that there was a desire for some further definition of these qualities, for the different trades upon which vessels are engaged. The conditions induced by the war have made the subject of national importance, as the new merchant fleet which will be brought into being should be such that the best results will be obtained with the minimum expenditure of material, labor, and time.

The ultimate object of all interested in shipping is that the vessels engaged shall transport the maximum amount of cargo in relation to their initial cost, and at the cheapest possible freight rate. The maxima and minima of these requirements are not coincident, and it is therefore necessary to compromise between them.

The initial cost of construction of vessels has varied greatly during different periods of the past, and this has made it difficult for owners having different sizes of ships built at different periods to estimate their relative efficiencies on a common basis; *i e.*, an unsuitable ship built in, say, 1908 might, on account of the very low initial cost, be able successfully to compete against another of better design built in 1913.

With the object of combining the interests of the designer, the owner, and the builder, and of eliminating a number of difficult corrections, the writer has endeavored to formulate a method by which the most economical dimensions can be arrived at for any length of voyage, condition of loading, or speed.

General

The efficient part of a vessel's working life is when transporting cargo from one port to another, and the period spent in loading and discharging, although necessary, can only be considered as lost time. The efficiency of a vessel transporting cargo at a minimum of speed (which will be defined later) can therefore be expressed as—

$$E = \frac{T - t}{T}$$

where T is a convenient total period of time, and t is the proportion of T which is required for loading, discharging, docking, etc.

Size of Vessel

There are many inducements towards building large vessels, the most important of which are—

(1) Reduced initial cost in relation to the deadweight.
(2) Reduced horsepower, crew, and amount of coal required in relation to the deadweight.
(3) Greater seaworthiness.

The problem cannot be considered sectionally, however, and an owner is sometimes prevented from utilizing these advantages fully on account of—

(4) The length of voyage.
(5) The increased length of time required to load and discharge a large ship (which time might for convenience be termed "Detention").
(6) The unsuitability of certain harbors, loading berths, and dry docks.
(7) Greater loss in case of mishap or disaster.

The lost time suggested under item 5 is of considerable magnitude, as the number of hatches or derrick systems which can be arranged in vessels of equal proportions will vary as $\sqrt[3]{\text{deadweight}}$, or, with holds of equal length, the work to be done at each hatch will vary as B, D, H, where B and D are the breadth and depth respectively, H (see Fig. 6) is the average distance through which the cargo has to be transported.

It will be seen from this and the figures in Table I that the average work to be done at each hatch in a 250-foot vessel is about 16,000 foot-tons as compared with 250,000 foot-tons in a 570-foot ship.

Items 1 and 2 represent savings in cost of transportation, whereas item 5 represents loss of invested capital, and it follows that the most suitable size of vessel is that which gives the best economic adjustment between these opposing factors. This can be illustrated diagrammatically.

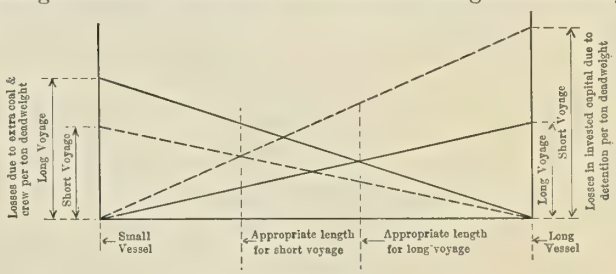

Losses due to extra coal & crew per ton deadweight
Long Voyage
Short Voyage
Losses in invested capital due to detention per ton deadweight
Long Voyage
Short Voyage
Small Vessel
Appropriate length for short voyage
Appropriate length for long voyage
Long Vessel

Diagram A

A relatively long voyage or rapid system of loading and discharging will increase the value of E, while an increase in dimensions or an increase of speed for a fixed length of voyage and fixed derrick speed will reduce it, and from these facts it may be presumed that length (or dimensions) may vary in some proportion to E.

Method of Calculating Results

The problem is, to find the dimensions which will give the best compromise between items 1 and 2 and item 5, and in order to obtain information covering a wide field, it was decided to calculate the possible working values of twenty-five vessels, for voyages of 1,000, 4,000 and 8,000 nautical miles, for two speeds of loading and discharging, and for service speeds of 8, 9½, 11, 12½, and 14 knots.

The designs were divided into five groups, each having lengths of 250 feet, 330 feet, 410 feet, 490 feet and 570 feet, and each group was sub-divided to give the speeds already mentioned.

The arrangement of each size of vessel is illustrated on Figs. 1 to 5, and the length of machinery space indicated

* Paper read at the spring meetings of the fifty-ninth session of the Institution of Naval Architects, London, March 20, 1918.

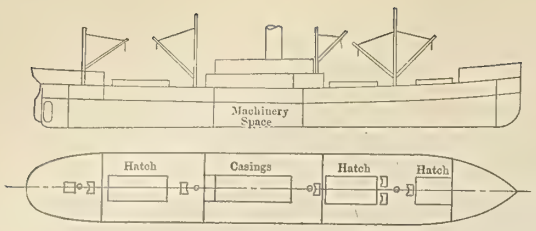


Fig. 1-250′x 37′x 18′6″

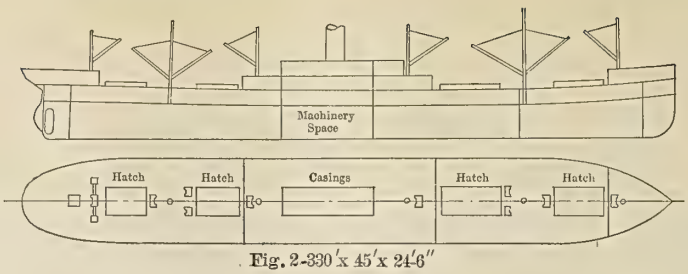


Fig. 2-330′x 45′x 24′6″

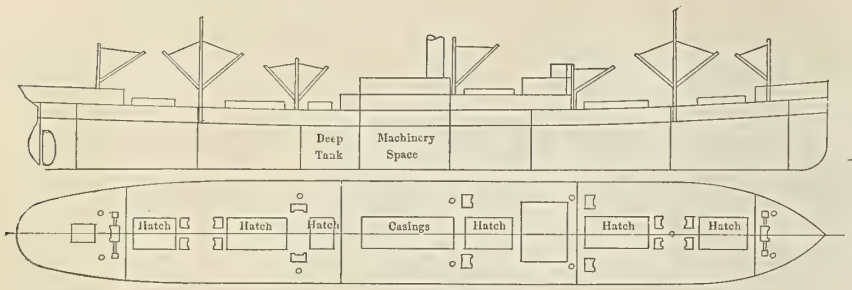


Fig. 3-410′x 53′x 30′5″

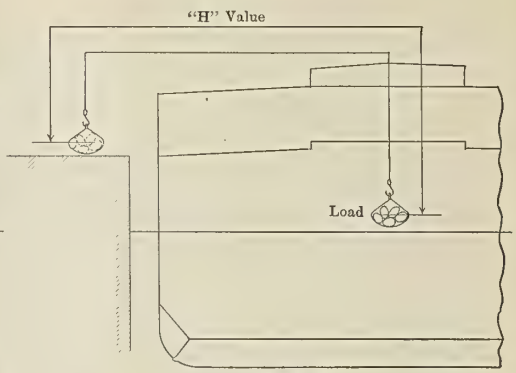


Fig. 6

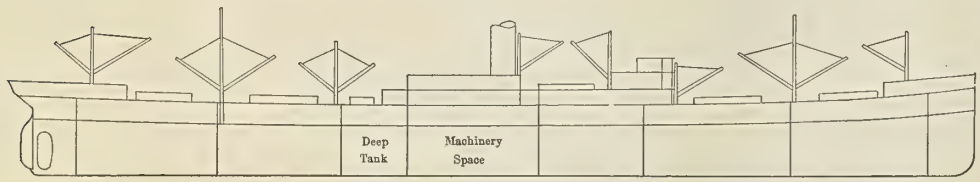


Fig. 4-490′x 61′x 36′4″

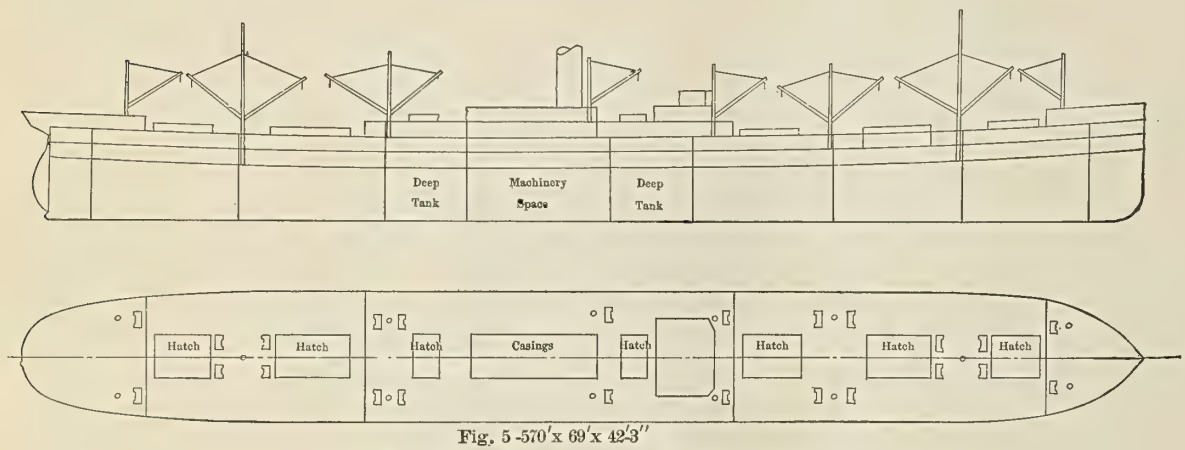


Fig. 5-570′x 69′x 42′3″

Sketches Showing Arrangement of Different Size Vessels

is for a speed of 11 knots. In the vessels above this speed it will be increased in length, but it was assumed that this increase would not affect the number of hatches or derrick systems.

Each vessel is of the poop, bridge, and forecastle type, these erections extending over about 50 percent of the vessel's length. The ratio of length to depth is 13½ times, this being the maximum which Lloyd's will allow with normal scantlings, and it may also be said that this ratio gives the maximum length for derrick arrangements and minimum draft in relation to the deadweight. The breadth has in each case been made equal to $\frac{\text{length}}{10}$ + 12 feet.

The number of winches and derricks systems were arranged to give the maximum number of receiving stations on the quay side, and it was assumed in the calculations that the derricks would be worked on the "yardarm" system if two winches were fitted abreast, and by "swinging" if only single winches were arranged.

It has been assumed that the bulkheads are placed so

TABLE I.—ESTIMATED QUALITIES FOR A VOYAGE OF 4,000 NAUTICAL MILES AND MAXIMUM DERRICK CAPACITY

Item No.	Particulars	Speed of Vessels, 11 Knots				
1	Dimensions	250′ x 37′ x 18′ 6″	330′ x 45′ x 24′ 6″	410′ x 53′ x 30′ 5″	490′ x 61′ x 36′ 4″	570′ x 69′ x 42′ 3″
2	Displacement, Tons	3,031	6,525	11,520	18,360	27,330
3	Draft	16′ 7½″	20′ 9½″	24′ 4¾″	27′ 11″	31′ 7″
4	Block Coefficient	.69	.74	.76	.77	.77
5	Service Horsepower	1,258	1,935	2,540	3,230	4,080
6	Weight of Vessel	1,152	1,934	3,260	5,234	7,515
7	Initial Cost of Vessel	£26,700	£44,700	£66,800	£104,900	£153,700
8	Net Tonnage	700	1,660	3,210	5,400	9,780
9	Crew	24	33	46	56	65
10	No. of Derrick Systems { Yardarm	1	2	7	11	12
	{ Swinging	4	6	2	.....	.....
11	Gross Deadweight	1,879	4,591	8,260	13,126	19,815
12	Coal Consumed per Voyage, Tons	389	566	754	978	1,257
13	Stores, Fresh Water, and Feed Water, Tons	61	90	121	161	196
14	Net Cargo Deadweight, Tons	1,388	3,885	7,356	11,987	18,362
15	Days on Run	15.15	15.15	15.15	15.15	15.15
16	Days in Port	2.37	4.15	6.75	8.95	13.09
17	No. of Runs per Annum	20.83	18.92	16.65	15.15	12.91
18	Total Cargo per Annum, Tons	289,10	73,500	122,500	181,600	237,000
19	Total Coal per Annum, Tons	8,102	10,710	12,550	14,820	16,228
20	Cargo Transported per Annum / Initial Cost of Vessel	1.082	1.643	1.834	1.731	1.542
21	*Cots of Operation per Annum* —	£	£	£	£	£
22	Brokerage and Management, 9d. per ton	1,084	2,757	4,594	6,810	8,888
23	Loading and Discharging, 1s. 6d. per ton	2,168	5,514	9,188	13,620	17,776
24	Coal, Oil, etc., at 12s. per ton	4,861	6,426	7,530	8,892	9,737
25	Tonnage Dues at 1s. 3d. per ton	913	1,965	3,345	5,120	7,904
26	Wages and Provisions	2,017	2,772	3,865	4,705	5,460
27	Depreciation, Insurance, Repairs (1–7 Initial Cost)	3,819	6,393	9,543	14,986	21,964
28	Total Outlay	£14,862	£25,827	£38,065	£54,133	£71,729
29	Profit to give 20 percent on the Initial Cost	£5,346	£8,950	£13,360	£20,980	£30,730
30	Rate per ton to give 20 percent Gross Profit	14s.	9s. 5½d.	8s. 4¾d.	8s. 3¼d.	8s. 7¾d.
31	Efficiency $\frac{T-i}{T} = E$	.865	.785	.692	.629	.536

that the work to be done will be equally divided between the winches or derrick systems.

The time required in port was estimated from the derrick capacity, and to obtain a basis for this it was decided to assume that the maximum amount which could be handled per day of 10 hours in the 410-foot vessels would be 360 tons per "yardarm" system and 276 tons per "swinging" derrick. Proportionate amounts were obtained for the other sizes of vessels by assuming that the time required for hooking and slinging the cargo would be constant, and that the time required for discharging would be proportional to the distance H. On this assumption the following values were obtained:

Length of Vessel.	Working Rate per Day of 10 Hours.	
	Yardarm System.	Swinging System.
250 feet	445 tons	360 tons
330 "	394 "	318 "
410 "	360 "	276 "
490 "	338 "	250 "
570 "	318 "	229 "

The writer is aware that these values are higher than is found in present-day practice, but he purposely kept them high to obtain a wide field and to cover possible future improvements in methods. In order to obtain the lower limit for working rates, alternative calculations were prepared on the assumption that the derricks would be worked at 45 percent of the rates given.

It should be pointed out that as these assumptions are made only for the purpose of calculating E values in relation to the different lengths of voyage, the quantitative working values are not of importance, and the only object in setting off the relative amounts for each size of ship is to show how the larger vessel may be penalized in discharging speed.

Table I indicates the method adopted for calculating the working values of the vessels, and the figures shown refer to the 11-knot speed for each size of vessel. The items are generally self-explanatory, but reference may be made to the following:

(*a*) The drafts are based on present regulations of the Board of Trade, and the block coefficients have been made appropriate to the service speeds. The dictum of the experienced shipowner has been followed with regard to the block coefficient, viz., that it should not exceed .77 whatever the speed may be.

(b) The "weight of vessel" used is that of a bare cargo hull to Lloyd's rules, with engines of triple expansion type, these driving twin screws where the service horsepower exceeds 5,200.

(*c*) An addition of 12 percent has been made to the calculated time in port, to allow for stoppages during holidays, week-ends, etc., and an allowance has been made for coaling during the 8,000-mile voyages. In addition to these, 14, 18, 22, 26, and 30 days respectively have been allowed for each size of vessel per annum for repairs and other delays, and these have been assessed at their rates per voyage. It has been assumed that coaling will be effected while the cargo is being worked.

(*d*) The coal per voyage has been estimated from a curve, the ordinates of which are 2 pounds per horsepower per hour at 800 horsepower, 1.7 pounds at 2,200 horsepower, and 1.6 pounds where the horsepower is 4,000 or more. The coal for port use has been assumed as proportional to the weight of cargo and the distance H. It was also assumed that vessels making an 8,000-mile voyage would be rebunkered at a port intermediate between the terminal ports.

(*e*) The net tonnage is that obtainable by Board of Trade regulations, and includes the present allowances for propelling space.

(*f*) The money values are not the present ones, but as they are comparatively correct between each size and speed of ship, and between initial cost of vessels and cost of transportation, they have no

influence on the results of the relative efficiencies. Notwithstanding this statement, however, the effect of increased labor and other rates has been investigated, and the results are given later.

(*g*) Line No. 20 in Table I gives the "tons carried" in relation to the initial cost of vessel, and line 30 gives the estimated freight rates. Cross curves of these have been drawn for each stated condition, and Figs. 7 to 9 illustrate these curves for three of the conditions.

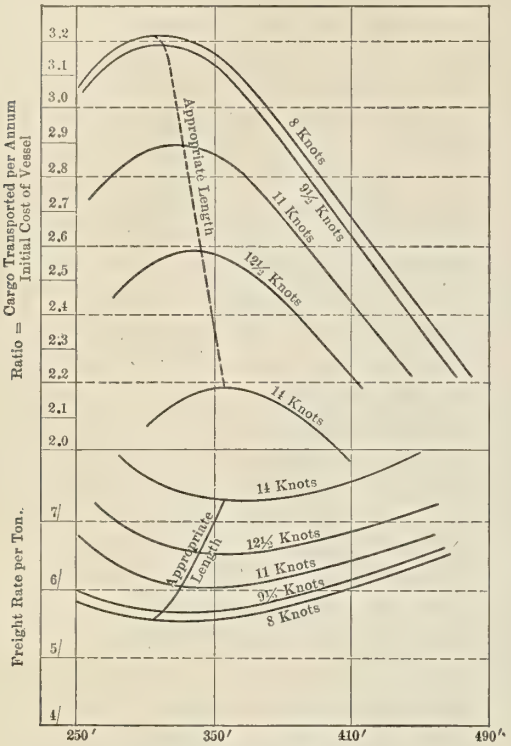


Fig. 7.—Scale of Length, 45 Percent Derrick Capacity, 1,000 Nautical Miles

RESULTS

It will be seen from these curves that the ratio of "tons carried" defines the appropriate length most prominently; but as cost of coal, labor, etc., must also be considered, it was thought necessary to fix the appropriate

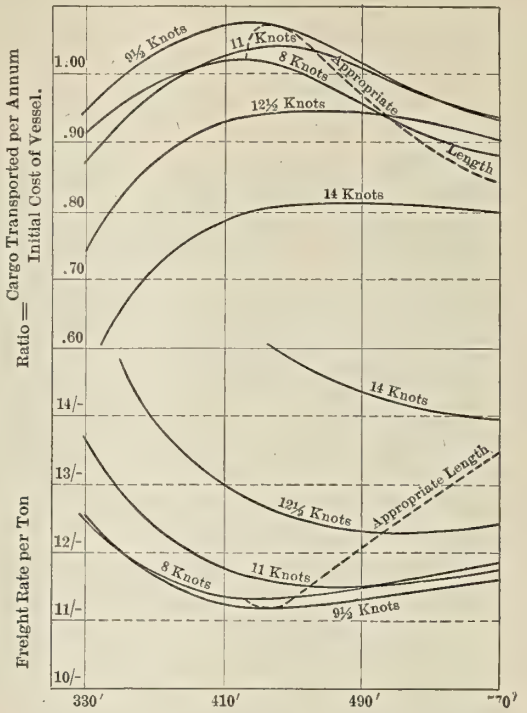


Fig. 9.—Scale of Length, Maximum Derrick Capacity, 8,000 Nautical Miles

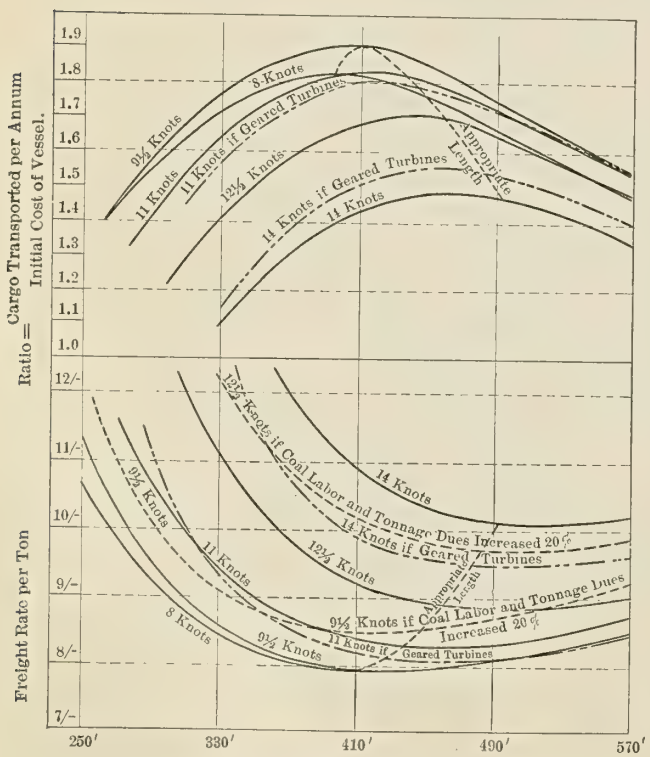


Fig. 8.—Scale of Length, Maximum Derrick Capacity, 4,000 Nautical Miles

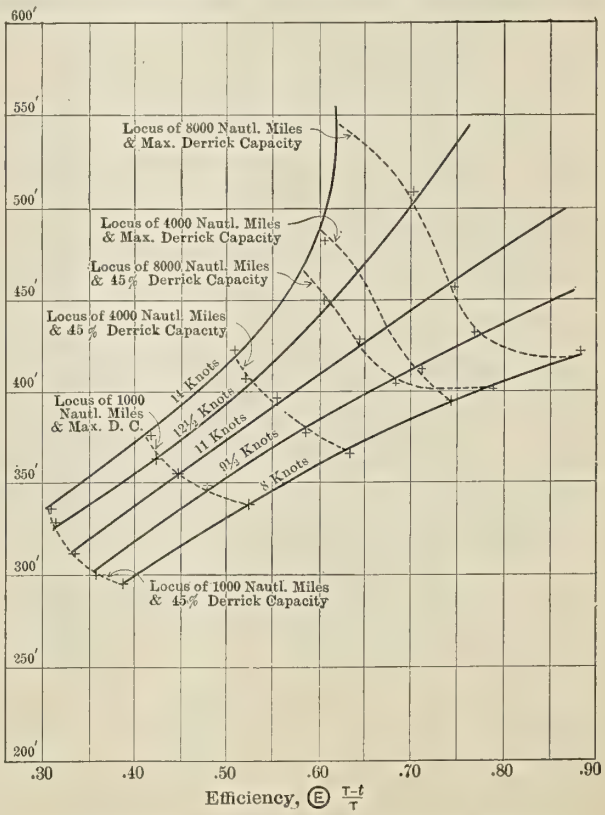

Locus of 8000 Nautl. Miles & Max. Derrick Capacity
Locus of 4000 Nautl. Miles & Max. Derrick Capacity
Locus of 8000 Nautl. Miles & 45% Derrick Capacity
Locus of 4000 Nautl. Miles & 45% Derrick Capacity
Locus of 1000 Nautl. Miles & Max. D. C.
Locus of 1000 Nautl. Miles & 45% Derrick Capacity
14 Knots
12½ Knots
11 Knots
9½ Knots
8 Knots
Efficiency, E = (T−t)/T

Fig. 10.—Appropriate Length in Terms of Efficiency

length line indicated, by interpolation, between the highest part of the "tons carried" curve and the lowest part of the "freight rate" curve.

To complete the main investigation, the appropriate lengths of each condition and distance have been plotted on a base efficiency E, and these results are indicated on Fig. 10.

The spots on this figure for the lengths appropriate to 8,000 miles and 45 percent derrick capacity are greater proportionately than those for 4,000 miles and maximum derrick capacity, the explanation of this difference being that the vessels on the longer voyage have intermediate coaling stations. The difference due to this fact does not, however, affect the results to any appreciable extent.

Figs. 7 and 9 represent the extreme limits of efficiency for the calculated conditions, their relation being $\frac{8{,}000}{1{,}000} \times \frac{1}{.45}$ = 17.8 times the loading speed, or length of voyage, and it is thought that from these and the curves on Fig. 10, lengths appropriate to best results for any known or average length of voyage, condition of loading or speed, can be obtained for vessels engaged in the carriage of cargo only and having no assistance from the revenue obtained by carriage of passengers.

To illustrate the effect of increased cost of coal, labor, and tonnage dues over the originally calculated amounts, additional lines have been indicated on Fig. 8 to show the effect of increasing the cost of these items by 20 percent, and it will be seen that although this would tend to increase the appropriate length such increase would not be of great magnitude.

Some calculations have been made to find the effect of vessels making return voyages in ballast trim, and it has been found that if the ballast run is estimated as an extended length of voyage, and not as lost time, in calculating the E value, a correct result will be obtained.

Fig. 11 gives the relative "tons carried" and "freight rate" in terms of speed for the appropriate lengths, and these have been plotted as a percentage of the best and lowest results. It will be seen that the most economical speeds are from 9 to 9½ knots, but it is understood that higher speeds are necessary when cargoes of a perishable nature are carried.

It has not been found convenient to illustrate the curves for each calculated condition of loading, but Table II is given to show the effect of altered discharging speed on the "tons carried" and "freight rate."

TABLE II.—TO SHOW THE EFFECT OF ALTERED DERRICK SPEED ON FREIGHT RATE AND TONS CARRIED AT THE APPROPRIATE LENGTHS.

Condition	Speed of Vessel	Derrick Speed	Freight Rate	Tons Carried
			s. d.	
1,000 nautical miles.....	9½ knots	Max. D.C.	4 9	4.89
" "	" "	45 percent "	5 8	3.19
	14 "	Max. "	5 9	3.49
	" "	45 percent. "	7 3½	2.18
4,000 nautical miles.....	9½ knots	Max. D.C.	7 11½	1.91
" " "	" "	45 percent. "	9 2	1.50
	14 "	Max. "	10 2	1.47
	" "	45 percent. "	12 7½	1.10
8,000 nautical miles.....	9½ knots	Max. D.C.	11 2	1.075
" " "	" "	45 percent. "	12 6	.916
	14 "	Max "	13 9	.82
	" "	45 percent. "	16 8	.687

Other Types and Proportions

The appropriate lengths shown on Fig. 10 will be applicable to other types of cargo vessels, provided that in comparing the dimensions of one vessel with another the characteristics and proportions are similar.

Stowage Capacity

Stowage capacity will often influence a designer in arriving at the most suitable size of a vessel, and it is found that the stowage rate per ton of cargo for fixed

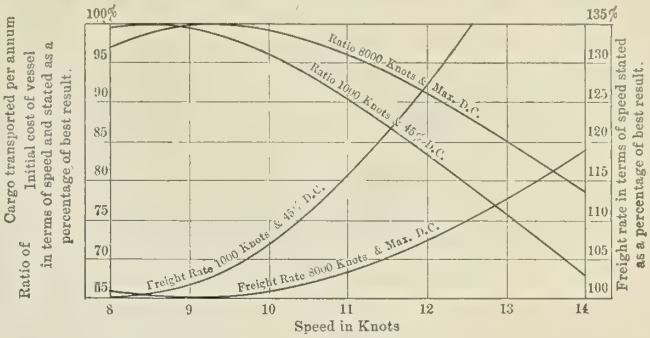

Ratio of Cargo transported per annum Initial cost of vessel in terms of speed and stated as a percentage of best result.
Freight rate in terms of speed stated as a percentage of best result.
Ratio 8000 Knots & Max. D.C.
Ratio 1000 Knots & 45% D.C.
Freight Rate 1000 Knots & 45% D.C.
Freight Rate 8000 Knots & Max. D.C.
Speed in Knots

Fig. 11

speed is reduced as length is increased; it may, therefore, in some cases be found profitable to choose a slightly shorter vessel than the curves indicate.

Improved Types of Machinery

The effect of geared turbine installations with double reduction gears has also been investigated from the particulars given on Fig. 12 and the results are plotted for speeds of 11 and 14 knots on Fig. 8. It appears that these improved propulsive elements with reduced coal consumption would not appreciably alter the appropriate length of vessel. They affect the earning power considerably, however, and on account of the present relatively high

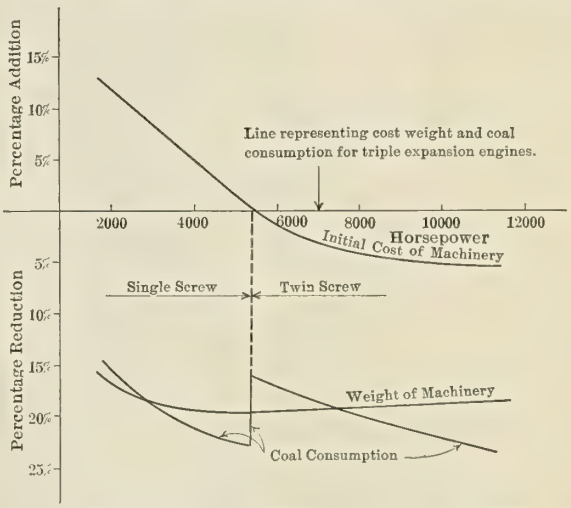


Fig. 12.—Diagram Showing Relative Values for Turbine Installations with Double Reduction Gearing in Comparison with Triple-Expansion Reciprocating Engines of Similar Power

initial cost of this type of engine for low powers, geared turbines are evidently unsuitable for speeds of less than about 10½ knots.

Conclusion

It appears from these investigations and the results of actual ships tabulated hereafter that the most suitable length of a "tramp" trader would be between 380 and 400 feet, with a speed of 9 to 9½ knots. The maximum efficiency E of the most up-to-date cargo liner does not exceed .60, which with a speed of 12½ knots would have a length of about 450 feet and a corresponding maximum draft of about 28 feet. In view of this maximum draft, it appears to be an open question whether the proposed deepening of trade routes should be considered prior to

legislation being completed for improvements in our harbors, such as increased berthing and loading facilities at quays, increased storage capacity, and the removal of many port restrictions which have caused detention to our ships in the past.

The curves of gross deadweight given on Fig. 13 will be found useful for comparing one vessel with another.

The writer desires to thank the directors of Messrs. Scotts' Shipbuilding and Engineering Company for their permission to publish these results. He also thanks the friends who have advised and assisted him in the development of these notes.

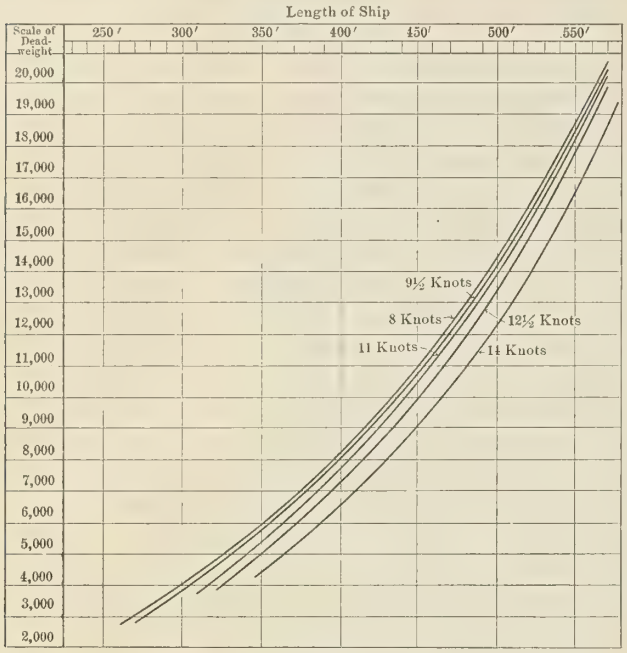


Fig. 13.—Gross Deadweight

Appendix

To show the possible use of, and the method of applying, the curves on Fig. 10 the following illustrations are given:

No. 1.—A cargo tramp, 400 feet in length, and having five hatches, each of which is worked by derricks at one end, has the following characteristics for the period under consideration:

Load deadweight	8,000 tons
Total steaming time	310 days
Total loading and discharging time	255 "
Total time for coaling, repairs, etc	30 "
Average service speed	10¼ knots

Is this the most economical length?

The total period T is	=	595 days
The efficient period $T-t$ is	=	310 "
Giving an efficiency of E		.52 "

The length corresponding to $E = .52$ and a speed of 10¼ knots from Fig. 10 is 370 feet, but this reduced length is accompanied by a reduced deadweight, and, consequently, an increased efficiency. This variation in efficiency suggests that a length of 380 feet might be tried, and the particulars would then be—

Deadweight (from Fig. 13)		7,050 tons
Time on voyage		310 days
*Loading and discharging time $255 \times \frac{7,050}{8,000}$		225 "
Time for coaling and repairs		30 "
Total period T	=	565 "
Efficient period $T-t$	=	310 "
Giving an E value of		.548 "
The corresponding and final length would then be		377 ft.

The detail curves for the condition nearest to this vessel's efficiency show that if the vessel had been 23 feet shorter the "tons carried" would have been increased by 1 percent and the "freight rate" reduced by ½ percent.

No. 2.—Proposed vessel for service between Bombay and Glasgow, or neighboring ports, a distance of 6,500 nautical miles. Speed on service 11 knots. Full cargoes can be obtained on all voyages, and it can be handled at an average of 150 tons per derrick system per day. Swinging derricks only to be arranged for, and the cargo can be handled over both sides of vessel at Eastern ports, but will be worked to and from a quay wall in Britain. The vessel will bunker before embarking and also at an intermediate port on each voyage. What is the most suitable length?

Try lengths of 360 feet, 400 feet, and 440 feet:

	Lengths		
	360 feet	400 feet	440 feet
	Tons	Tons	Tons
Gross deadweight per Fig. 13	5,750	7,750	9,900
Less coal for half voyage 530	620	710	
Less stores, fresh water, etc 100	120	140	
	630	740	850
Net cargo to be handled	5,120	7,010	9,050
Number of derricks on each side	8	9	10
	Estimated time per trip		
	Days	Days	Days
Time to load at Bombay	4.27	5.20	6.03
Time to discharge at Glasgow	8.54	10.40	12.06
Time to coal on route	2.00	2.00	2.00
Time for shifts in harbor, etc., and all other delays	3.00	3.00	4.00
Total lost time	17.81	20.60	24.09
Total time at sea	24.60	24.60	24.60
Total time per trip	42.41	45.20	48.69
Efficiency (E)	.58	.545	.50
Lengths per Fig. 10 for these efficiencies	402 ft.	389 ft.	376 ft.

Column 2 gives the best agreement between the trial and the resulting lengths, and the most suitable length would be about 395 feet long.

No. 3.—Vessel 600 feet long engaged on a voyage of 5,000 nautical miles, and having a service speed of 12 knots. Thirteen derricks are arranged on each side, and these load or discharge from lighters on each side at each terminal port, each at the rate of 200 tons per day. Is this the most suitable length?

Gross deadweight (from Fig. 13)		23,500 tons
Less coal, stores, fresh water, etc		1,900 "
Net cargo to be handled		21,600 "
Time required to load and discharge $\frac{21,600 \times 2}{26 \times 200}$		8.3 days
Time required for coaling and shifting		3.0 "
Average time lost for repairs, etc., per voyage		2.7 "
Total lost time per voyage		14.0 "
Total time sailing		17.4 "
Total time per trip		31.4 "
Efficiency (E) $\frac{17.4}{31.4}$	=	555
Length corresponding to this efficiency from Fig. 10	=	412 feet

It is evident that the efficiency will improve considerably with this reduced length, and on this account a length of 460 feet having ten winches each side might be tried.

The particulars would then be—

Gross deadweight (Fig. 13)		10,700 tons
Less coal, stores, fresh water, etc		1,200 "
Net cargo to be handled		9,500 "
Time required to load and discharge $\frac{9,500 \times 2}{20 \times 200}$		4.75 days
Time required for coaling and shifting		2.45 "
Average time lost for repairs, etc., per voyage		2.0 "
Total lost time per voyage		9.20 "
Total time sailing		17.4 "
Total time per trip		26.6 "
E value		.654 "
Corresponding length		460 ft.

This smaller vessel would transport 15 percent additional cargo in relation to the initial cost, and the freight rate would be reduced by about 4 percent.

* Estimated from the 400-foot ship in relation to the deadweight.

TABLE III.—PARTICULARS OF THE WORKING QUALITIES OF CARGO SHIPS COMPARED WITH THE CALCULATED RESULTS GIVEN BY FIG. 10

No.	Trade Route	Approximate Length of Voyage	Length of Ship	Service Speed (Knots)	Total Time per Trip (Days)	Steaming Time (Days)	Corresponding E Value	Length from Curves, Fig. 10*	Remarks
			Feet		T	$T-t$		Feet	
1	Liverpool and United States	8,500	410	10.25	63	34.7	.55	390	Round voyage, outward in ballast, average of 4 voyages.
2	Liverpool and United States	11,000	365	10.60	82	47	.574	382	Round voyage, outward in ballast, average of 3 voyages.
3	Liverpool and Far East	25,000	390	10.70	149	99	.665	420	Average of 4 round voyages.
4	Liverpool and Pacific Coast	30,000	503	13.00	161	94	.585	460	Average of 4 round voyages.
5	Liverpool and Far East	25,000	452	13.80	128	71	.555	445	Result of 1 round voyage.
6	Leith to Far East	25,000	390	10.30	182	105	.575	388	Result of 2 round voyages.
7	British & Continental Coasting	1,500	215	8.0	16	7.1	.445	276	Result of 3 years' service.

* Corrected for change of efficiency due to change of length and number of derricks in terms of gross deadweight.

The writer is not aware of any existing vessels of the basis particulars in this latter case, but such a length, speed, and length of voyage has been suggested by Sir John Biles in his paper to the Institution in the year 1900.

Table III gives the actual working qualities of seven vessels, and indicates how their lengths as built compare with the calculated lengths.

Efficient Production at the Essington Works of Westinghouse Company

The Essington works at South Philadelphia, the huge plant of the Westinghouse Electric and Manufacturing Company built within the last year, is now in full operation, and all of its departments are running day and night as well as Sunday in completing one of the largest contracts for marine propelling machinery in this country. This order consists exclusively of apparatus for the United States government, and is a part of the enormous shipbuilding programme carried on by the Emergency Fleet Corporation.

The work under construction in the Essington factory covers the power equipment for three hundred and fifty ships. One hundred and fifty of these are for the Submarine Boat Corporation at Newark, N. J.; sixty for the Merchant Shipbuilding Corporation at Harriman, Pa., and Chester, Pa.; twenty for the United States Shipping Board; sixteen for the Chester Shipbuilding Company, and four for the Newburg Shipbuilding Company. The apparatus called for in this immense contract includes the complete installation on all these vessels of the Westinghouse marine power system, consisting of steam turbines, mechanical reduction gears, condensers, pumps with turbine drives, air separators, propeller shafting, stern tubes, bearings and other auxiliary steam apparatus. This system, which the Westinghouse Company has built for years at its East Pittsburgh plant, is the same as already largely installed in the United States Navy and in the Russian as well as in the Swedish marine service.

At the present moment the Essington works has actually under way in its foundry, machine and erection shops some seventy-five complete equipments. Of this number the foundry has finished its part for fifty turbines of the Submarine Boat Corporation contract, thirty sets of the reduction gears and forty-five of the condensers. This department has also completed the large castings for thirty turbines of the Merchant Shipbuilding Corporation order along with twenty-five of the reduction gears and twenty of the condensers. Besides this the foundry has well in hand all the auxiliary or smaller apparatus for the entire order.

The machine shops are working at present on the large parts for the forty-second Submarine Boat Corporation turbine, the fifteenth set of reduction gears and of condensers. They are also engaged on the tenth turbine equipment for the Merchant Shipbuilding Corporation order, along with the fifth set of reduction gears and the third set of condensers.

In the erection shops, where the finished parts of the apparatus are assembled, tested and then shipped, there are now under way in various stages of completion fifteen vessel equipments, which will be ready to leave the factory for their destination within the next thirty days.

While it was to have been expected that in a new works, where production was going on at the same time that building operations were under way and factory equipment was being installed, numerous difficulties and delays would be encountered, the works' organization is making wonderful progress, and the management has every confidence in finishing all the work on the original schedule dates.

At the present time the company has about four thousand operatives on its pay roll, consisting largely of high-class machinists and skilled mechanics. The plant, which is one of the largest in the Philadelphia industrial district, represents the most modern development in factory construction, its equipment in high-class machinery alone amounting to millions of dollars.

In accordance with arrangements made by the Westinghouse Company with the Emergency Fleet Corporation, there are now in course of construction near the Essington works two hundred houses for the accommodation of the employees. These are expected to be ready for occupancy by the first of October.

New Orleans Rushes Harbor Improvement Work

The harbor improvement project officially known as the Inner-Harbor-Navigation Canal of the Greater Port of New Orleans, which is being carried out with all possible speed by the Board of Commissioners of the Port of New Orleans, consists essentially of a navigable channel 30 feet deep, with a bottom width of 150 feet and a water level width of 330 feet, extending through the city of New Orleans a distance of nearly six miles from the Mississippi River to Lake Pontchartrain. At the Mississippi River end of the canal a 600-foot lock 75 feet wide and 30 feet deep will be provided to preserve the level of the water in the canal at the Lake level, which varies only a foot or two during the year, while the Mississippi River has a flood variation of nearly 20 feet at this point.

When the project is completed, New Orleans will have within the city a large inner harbor of practically fixed level, with marine terminals, industrial and storehouse sites accessible to rail, highway and ocean commerce.

Work on the project was begun on May 20, and plans call for its completion in eighteen months. The total cost is estimated at about $6,000,000 (£1,230,000). The project was designed and is being carried out under the direction of George W. Goethals & Company, consulting engineers, New York.

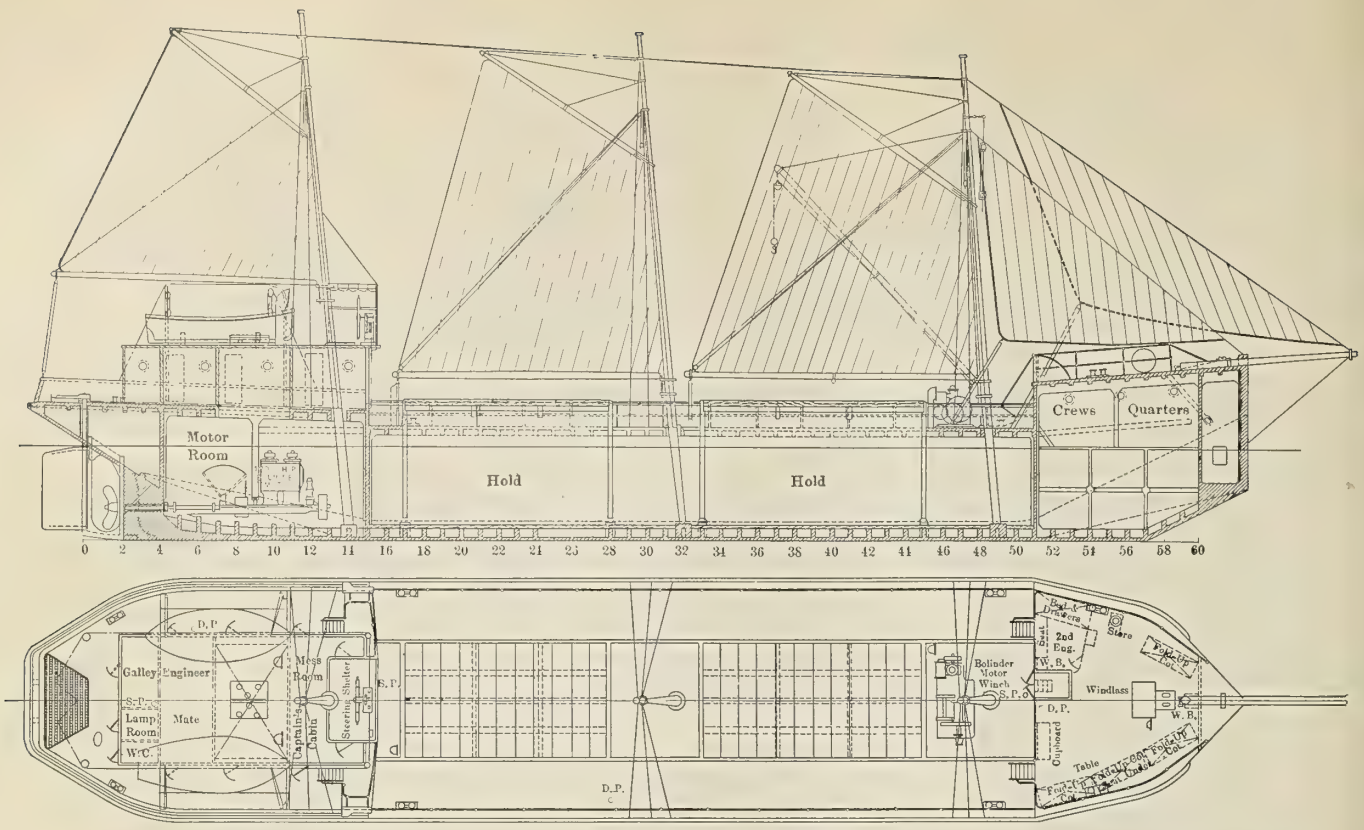


Fig. 1.—General Arrangement of Reinforced Concrete Motor Coaster, 125 Feet Long Between Perpendiculars, 25 Feet Beam and 11 Feet 9 Inches Molded Depth

Reinforced Concrete Vessels*

Discussion of Factors Involved in Designing Small Coastwise Concrete Motorship

BY WALTER POLLOCK

THE first reinforced concrete boat was a small rowing boat built and patented by M. Lambot, of Carces, France, in 1849. Apparently nothing further was done until 1887, when the sloop *De Zeemeuw* was built in Holland, and has been in constant service since, including work among ice, and is reported to be still in good condition. In 1896, C. Gabellini, of Rome, made a rowing boat by plastering cement and sand on both sides of a steel wire mesh, making a total thickness of 1 inch. In 1905 this same firm constructed the lighter *Liguria* and, following its seagoing trials, several other cargo vessels. It is stated that there are now in Italy vessels and pontoons which have been tested under severe loading to the satisfaction of Italian naval officers. In 1909 a barge or lighter carrying 220 tons was built in Frankfort-on-Main for the transport of gravel.

In 1910 a concrete scow was built in San Francisco 100 feet by 30 feet by 7 feet and of 525 tons carrying capacity. In 1911 concrete barges were built on the Panama Canal, 64 feet long by 24 feet wide, with a depth of 5 feet 6 inches. In the same year a barge was built by Mr. O. F. Lackey, of Baltimore, length 50 feet, breadth 22 feet, and depth 7 feet, carrying 86 tons of cargo. As a result of the experience with this barge, a concrete scow of 500 tons was built in 1912 by the First Concrete Scow Construction Company, of Baltimore.

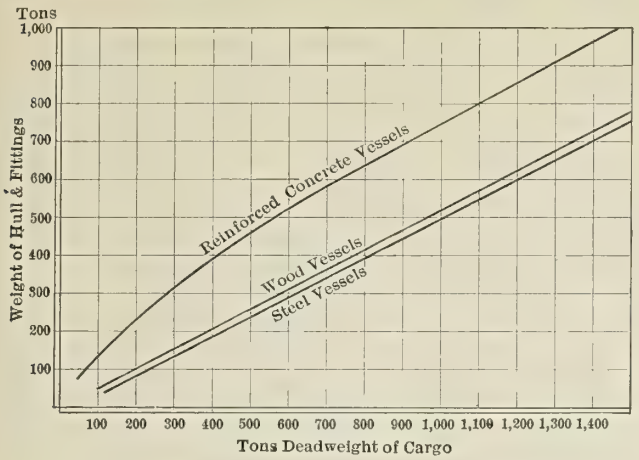
Among more recent constructions may be mentioned the *Namsenfjord*, a coaster of 200 tons deadweight built by the Fougner Company, of Norway, in 1917. The *Beton I*, another 200-ton vessel, was launched keel uppermost in August, 1917, by the Porsgrunds Company, Norway. A 5,000-ton deadweight capacity vessel is now being built in San Francisco, length 320 feet, breadth 45 feet, depth molded 31 feet, draft 24 feet, and is to be fitted with steam machinery of 1,750 horsepower.

For river and harbor lighters, tugs and coasting vessels, this form of construction will, if all the present experimental vessels are successful, probably remain a recognized form of construction for some years to come. Steel vessels may come back to their own as soon as freights are low and the competition keen. For larger vessels, up to, say, 2,000 tons deadweight capacity, reinforced concrete will no doubt prove a practical and commercial proposition for a few years.

Particulars are given above of a vessel of 5,000 tons being constructed in San Francisco, but it is difficult to see the advantage of using concrete in this case, as the amount of steel required for reinforcement, etc., will probably amount to 75 percent of that of a steel ship of the same deadweight capacity. The gain, together with the saving

* From a paper read before Institution of Naval Architects, London, March 22.

in skilled labor, seemed hardly sufficient to warrant the increased weight. It therefore seems probable that immediately the really critical situation as regards steel and skilled labor is passed, large vessels will no longer be constructed of concrete.



A.—Curve of Comparison of Weights

Designers and builders are striving to produce a reinforced concrete vessel:

(*a*) That will as nearly as possible reduce the weight of the hull to that of a steel ship of the same deadweight capacity.

(*b*) That will contain not more than one-quarter or one-fifth of the steel that is required in a steel ship.

(*c*) That will be sufficiently strong and safe with a thin concrete hull to stand stresses and ordinary knocks, and at the same time have the necessary density to ensure watertightness.

(*d*) With a concrete that will not fracture by expansion

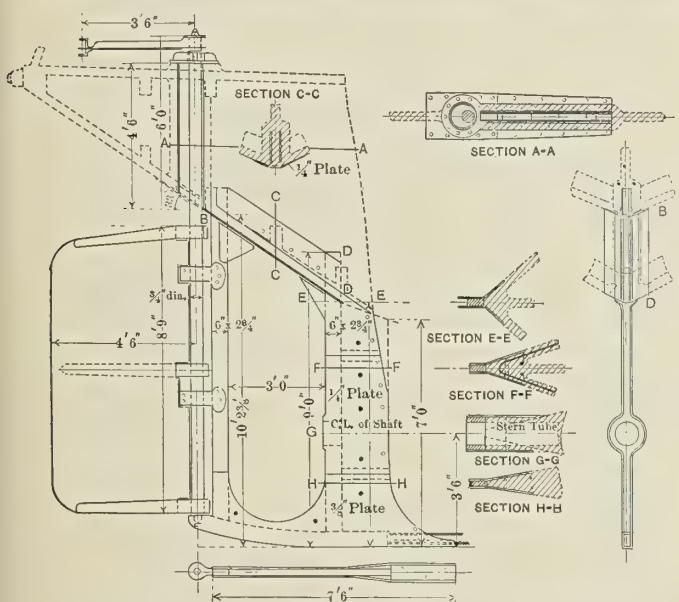


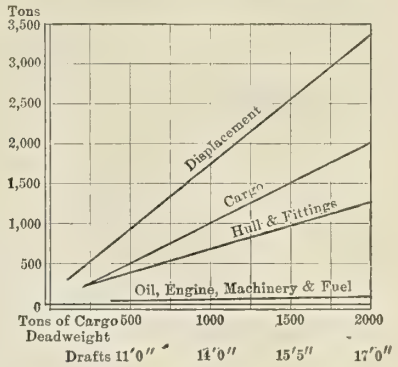
Fig. 2.—Patent Stern Frame for 125-Foot Reinforced Concrete Motor Coaster

and contraction, and that can be protected from disintegration in contact with acids, etc.

(*e*) That can be launched quickly after completion, without danger to the concrete work.

(*f*) That, after bottom and side damage has been repaired, can be put to work again quickly without waiting several weeks for the repair work to set and harden.

From the naval architect's point of view there are no great difficulties in the design and construction of concrete vessels. River vessels have to provide only for ordinary hydrostatic pressures, except where they have to ground on an even bottom, and the shocks and stresses due to coming in contact with other vessels, quay walls, etc. Seagoing



B.—Displacements, Weights and Cargo

vessels have to provide for dynamic forces due to mooring, berthing, docking, etc., as well as sagging, hogging and torsional strains when striking or falling in a heavy sea. The vibration of a ship in ballast after striking a wave may be found one of the most serious problems in concrete ships.

The bending and hogging strains due to wave conditions can be readily calculated, but the torsional and racking strains cannot. Shallow draft and river vessels, having as a rule only the strains due to unequal loading, grounding, etc., thus allow the scantlings to be lighter than is necessary for seagoing vessels.

The ideal design would appear to be a vessel with longitudinal construction (dispensing with two-thirds of the usual floors and frames), fitting only a few web-frames and as many bulkheads as possible, and in addition to the

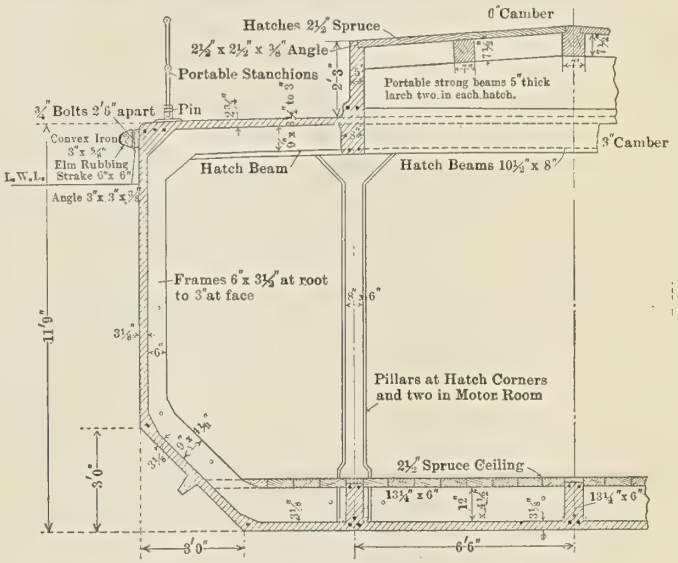

Hatches 2½" Spruce
0" Camber
2½" x 2½" x ⅜" Angle
Portable Stanchions
Portable strong beams 5" thick larch two in each hatch.
¾" Bolts 2'6" apart
Pin
Convex Iron 3" x ⅝"
Elm Rubbing Strake 6" x 6"
L.W.L.
Angle 3" x 3" x ⅜"
Hatch Beam
Hatch Beams 10½" x 8"
3" Camber
Frames 6" x 3½" at root to 3" at face
11'0"
Pillars at Hatch Corners and two in Motor Room
2½" Spruce Ceiling
13¼" x 6"
3'0"
6'6"

Fig. 3.—Midship Section of 125-Foot Reinforced Concrete Motor Coaster

usual longitudinal rods, a series of diagonal ones. In larger size vessels it would no doubt be advisable to fit a center bulkhead for the full length of the ship, but in any case it is advisable for cargo vessels to have the hatch coamings continuous all fore and aft, as shown in Fig. 1. In smaller vessels a continuous carling, even if it projects 6 inches above the deck, is desirable.

The calculations are in general similar to those of a

steel ship. A set of curves of bending moments and shearing forces for a 300-ton deadweight vessel are given in Figs. 4 and 5.

It is not difficult to design a reinforced concrete vessel with graceful form, nice curved lines and a handsome sheer, though difficulty and expense are involved in building and in keeping the steel reinforcements in place during molding and casting. To overcome these difficulties, the author designed the "straight-lined" vessels in July,

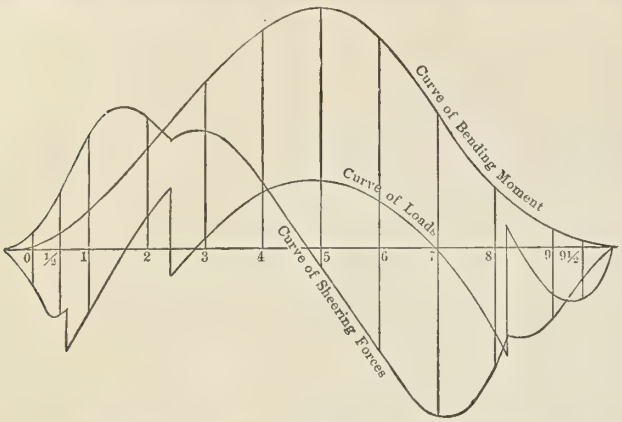


Fig. 4.—Crest of Wave. 1,300 Foot-Tons Maximum Bending Moment (Hogging)

1917, and published a number of designs wherein all the transverse sections are straight lines throughout the ship, the sheer being also in straight lines. The central portion of the ship for more than two-thirds of the length is rectangular, except for the angle of the bilge, which forms a double chine (see Fig. 3 and Fig. 7).

If the steel reinforcement is not kept in its proper position both vertically and horizontally in the thin slab walls of the shell, bulkheads, hatch coamings, bulwarks, casings, etc., a considerable amount of the strength of the reinforced concrete structure will be sacrificed. It is almost impossible to keep all the steelwork in its proper position,

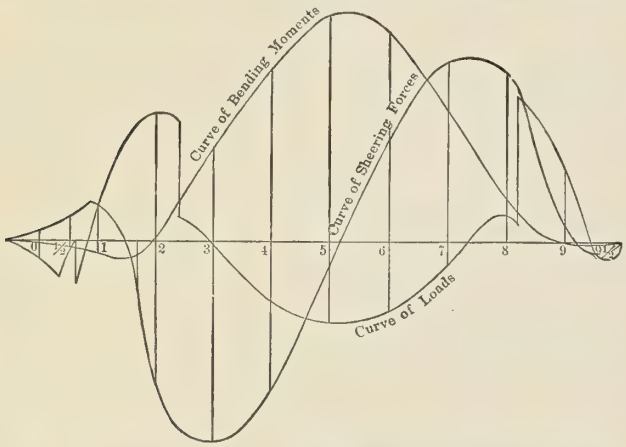


Fig. 5.—Hollow of Wave. 1,230 Foot-Tons Maximum Bending Moment (Sagging)

and a deviation of the bars one side may bring them so close to the surface as probably to throw off the concrete, or if set inwards to reduce considerably the strength of the slab locally. Furthermore, if the steel rods be not true to line, they tend to straighten out when subject to a tensile pull and cause the concrete to burst off, besides reducing their effectiveness by introducing secondary stresses.

The unit method of construction is being tried, but the advantages for ship work have yet to be proved, while the disadvantages are serious; so that the monolithic system, which makes it easy to obtain continuity of strength, is almost universally used.

For small vessels, barges, etc., a slab form of construction (Fig. 10) should be much more economical, as it dispenses entirely with floors and frames, side keelsons, stringers, beams, etc. The shuttering, being reduced to a minimum, is quickly placed in position and more rapid construction attained.

Bulwarks and hatch coamings are difficult to design for avoiding damage while loading or discharging cargo. The former can therefore be dispensed with and hinged stanchions and lifelines substituted, especially if the hatch coaming is made continuous. The latter should have a strong top and rest bar to avoid damage (see Fig. 9).

Fenders are necessary for all concrete vessels to protect the concrete, but in an experimental barge of 130 tons deadweight capacity fenders have been entirely dispensed with on the advice of the concrete designer, the corners of the gunwale being well rounded and finished off with a mortar of one of cement to one of sand, so as to avoid being chipped when coming in contact with or striking other barges. A solid half-round for the gunwale, as shown on Fig. 10, and other chafing irons, are desirable and may prove an advantage. It would be advisable to

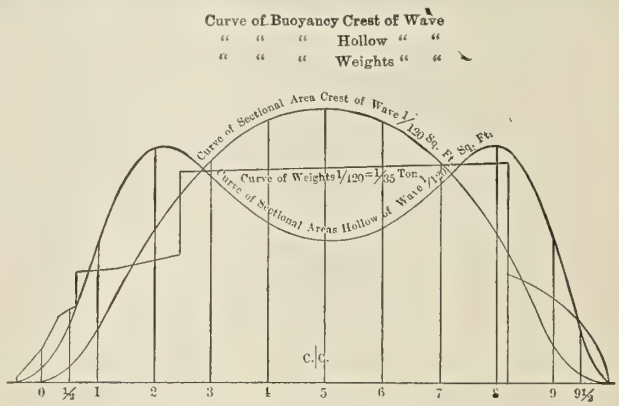


Fig. 6.—Curves of Buoyancy

fit fenders to all vessels as a precautionary measure, at least for the present, following the usual method of fitting close against the concrete work instead of a few inches off the shell with wood chocks in way of the bolts. A fender at the bilge, as shown on Fig. 9, will protect the concrete, and at the same time act as a bilge keel. All edges or corners throughout the vessel should be rounded or beveled where possible to prevent being chipped or broken off. If the concrete is subject to considerable rubbing or chafing, it will wear away.

There are the following methods of reinforcement:

(*a*) Wire netting, expanded metal, and similar meshwork with or without bars.
(*b*) Flat bars, special bars, steel joists, etc.
(*c*) Round bars of varying diameters.

All of these are suitable for either the unit method or the monolithic method of construction, and may be used either singly or in combination.

The wire netting and expanded metal is not likely to be adopted for the shellwork of seagoing vessels, because of the difficulty in keeping it true to line and obtaining homogeneity, as well as its excessive cost and the difficulty in varying the network sufficiently to suit the stresses.

Various sections other than round bars have been adopted in a number of cases, especially in America, but no doubt the round bars will be generally adopted, because they utilize the steel without waste, are easy to arrange

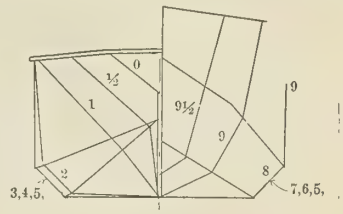
in position, easier to bend, more readily obtainable, and adapt themselves to a minimum quantity of concrete. Some claim that mechanical bars (to which kind all special bars belong) develop greater adhesion than round bars, but many reinforced concrete experts think the claim fallacious.

The larger steel bars are arranged longitudinally, generally in way of the deck line and the bottom of the ship, while there are also rods of nearly the same size arranged transversely, the whole being connected by small bars from 3/16 inch to ¼ inch, forming, say, a 6-inch mesh over the whole surface, making as far as possible a monolithic structure, a reduction in the number or total sectional area of the rods, both longitudinally and transversely, being arranged towards the ends of the vessel.

There are four methods of jointing the steel rods: (1) by a long overlap, (2) by a short overlap with hooked ends, (3) by welding, and (4) by turnbuckles or other mechanical attachment. The long overlap, which is usually 40 diameters of the rod, although some go as low as 20 diameters, relies entirely upon the adhesion or grip of the concrete to the bar. The short overlap of, say, 12 diameters in the small rods and 18 diameters in the rods over 1 inch diameter relies mostly upon the hooked ends and appears to be a satisfactory solution, as it reduces weight without sacrificing strength. Welding is certainly the most economical as regards weight, but if done in the shop makes the rods difficult to handle and keep in shape, and if in place may result in a local weakening of the rod at the weld. A mechanical connection, such as a turnbuckle, to unite screwed ends of the rods, is sometimes adopted for special purposes. The cost of welding and mechanical connection is usually considered prohibitive. In each of the above cases the loss due to the weakness of all riveted seams or butts in a steel ship is avoided.

In order to resist the diagonal tensile stresses induced in a beam by the action of the shearing force, stirrups are frequently introduced extending between the tension and compression members. They may be considered as the web members of a truss system, the triangulation of which will vary as they are placed vertically or diagonally.

While there is a well-defined theoretical method employed by designers of reinforced concrete structures for the determination of the sections, the calculations depend upon the use of coefficients determined from experiments which have all been made upon concrete under the condi-



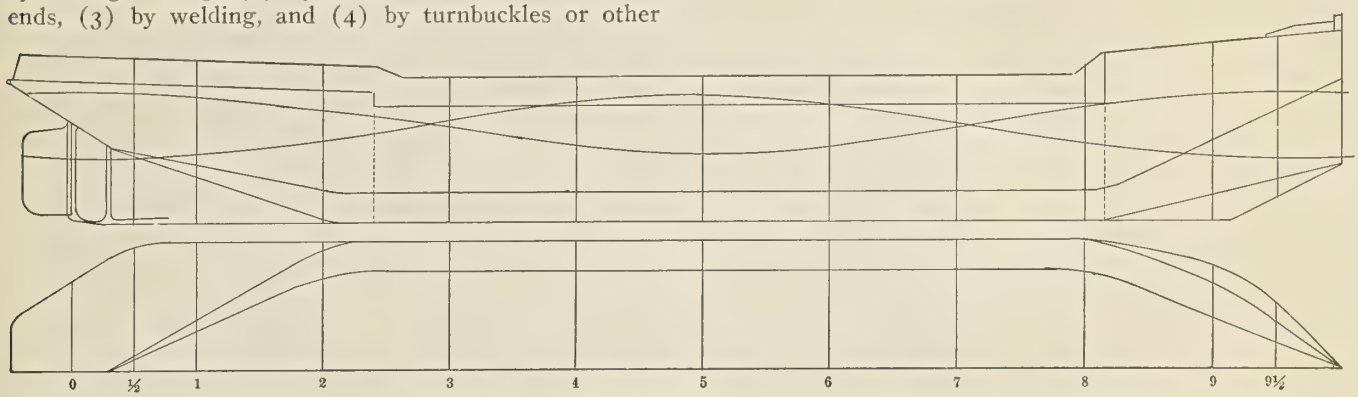


Fig. 7.—Lines of Modified Type of Reinforced Concrete Coaster

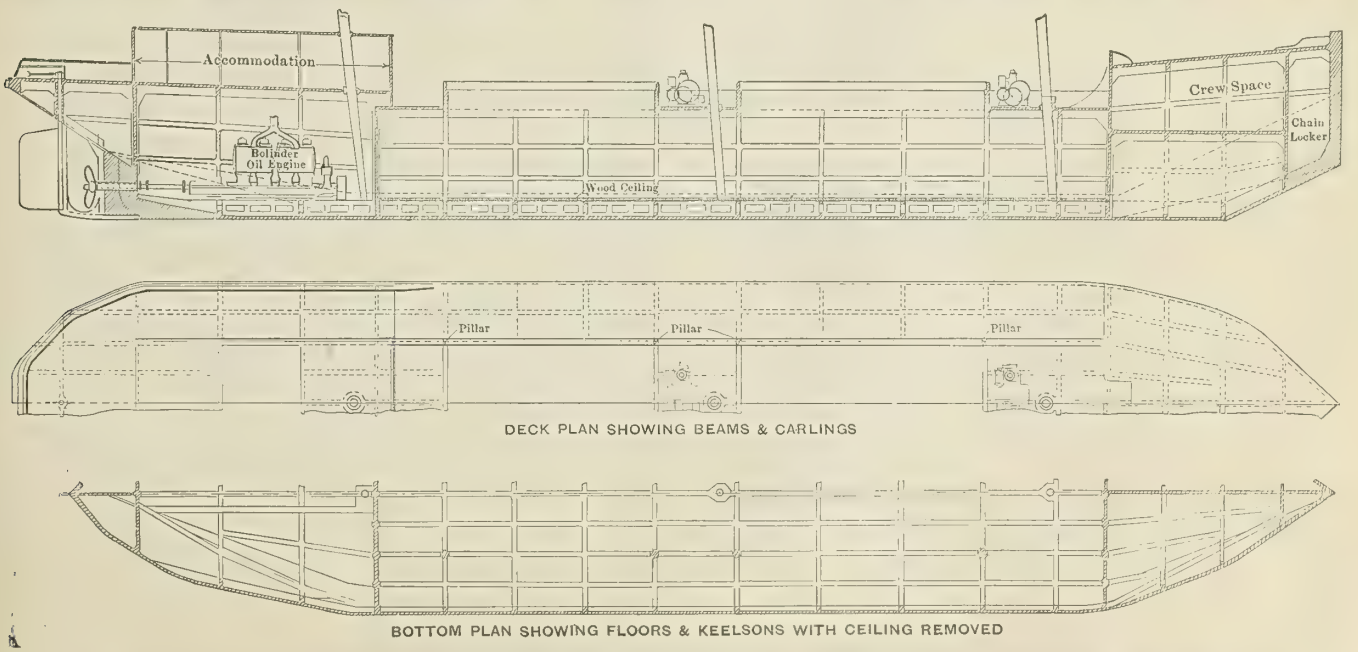


Fig. 8.—General Arrangement of 500-Ton Reinforced Concrete Coaster. Length Between Perpendiculars, 155 Feet; Beam, 29 Feet 6 Inches; Depth, Molded, 13 Feet 3 Inches

tions in which it is employed in buildings, and consequently the experimental data for shipbuilding work have yet to be derived. For this reason the paper leaves out consideration of the usual practice in allowable stresses which might, if included, lend color to the supposition that calculations could be made quite definitely on the present experience.

For deriving the equations for determining the properties of reinforced concrete sections, it is necessary to know

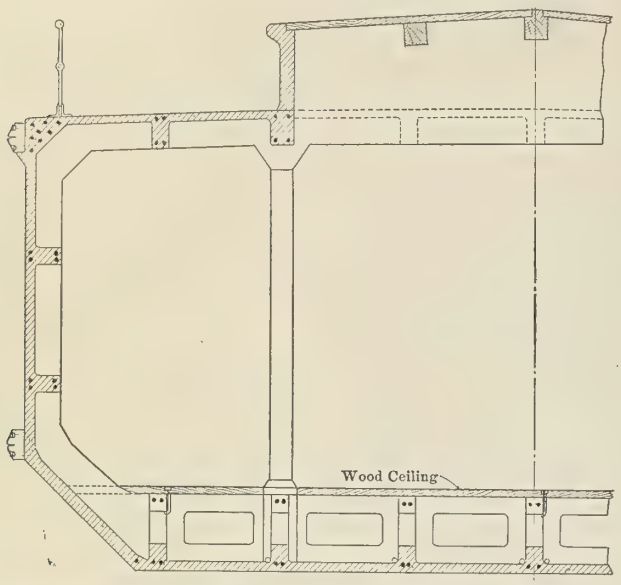


Fig. 9.—Midship Section of 500-Ton Reinforced Concrete Coaster

the moduli of elasticity for concrete and steel and the ratio as used in combination, because, while the modulus of steel is fairly constant up to the yield-point and is well known, the moduli of concrete vary with the quality of the concrete and the stress upon it, the modulus being greatly reduced as the stress increases. Therefore, in a reinforced concrete beam the ratio of the moduli of elasticity that is used for determining the position of the neutral axis and the other properties of a section is not the ratio that exists between the initial moduli of elasticity of the two materials. As the modulus of the concrete would vary to some extent with the constant or intermittent immersion of water, it is evident that the ordinary modular ratio of 1 to 15 that is used for structures may not be at all appropriate, having regard to the richer mixture of concrete employed and the greater factor of safety previously advocated.

The resistance of concrete to tension is generally neglected and it seems desirable to neglect it in ship design, but attention should be given to the fact that concrete is comparatively weak in tension, and therefore may be rather unsound for some part of the full thickness of the section, and consequently the watertightness depends on a section of less thickness.

It seems advisable at the present time to employ a factor of safety of 6 as regards the crushing strength derived from experiments on concrete blocks made in the ordinary way and allowed to dry out in the air, such crushing strength being that obtainable at three months. It will be found advantageous to employ concrete richer in cement than that ordinarily used for buildings, and made with ballast or other coarse material (sometimes called aggregate) restricted in size. There is also another element in question, as to what reduction in stress, if any, should be allowed in concrete which is always kept in water and that which is alternately wet and dry, while it is necessary in addition to ascertain what effect salt water has on the strength of concrete used in a vessel, although data go to show that salt water has no effect on a dense concrete.

The weight of reinforced concrete hulls is the most serious problem in the adoption of this type of vessel, the concrete being 143 pounds per cubic foot, plus the reinforcement. The bare hull with fittings of a coasting vessel of, say, 300 tons deadweight will weigh 130 percent more than that of a steel vessel, while the increase in total displacement is about 40 percent (see table below). Put in another way, if a concrete coaster was built of the dimensions and coefficient of fineness of a 420-ton deadweight steel vessel, it would only carry 300 tons deadweight on the draft.

The linear increase (length, breadth and depth) would be 12 percent to 14 percent greater for a concrete vessel than for a steel vessel.

The figures in the table of the 300-ton concrete vessels are based on the ordinary method of construction as shown in Fig. 1, and not the author's improved method of construction shown in Fig. 8. The practice of stating that a concrete hull is from 50 percent to 70 percent heavier than a steel vessel of the same dimensions does not give a fair comparison, because the concrete hull would carry much less cargo. The method of comparing the weights to vessels of similar deadweight has therefore been adopted.

It will be seen that the total steel is only 27 percent, the reinforcement alone accounting for 25 percent of that of a steel vessel of the same deadweight capacity.

The weight of the bare hull of the 500-ton vessel, illustrated by Figs. 8 and 9, is only 400 tons, which shows a reduction of 15 percent as compared with the figures of the 300-ton concrete vessel.

A 1,000-ton deadweight towing lighter would weigh about 90 percent to 100 percent more, the displacement being about 25 percent more, and the linear increase 7 percent more than that of a steel lighter of the same deadweight. The percentage difference in weight gradually decreases up to, say, 2,500 tons deadweight.

COMPARISON OF A 300-TON DEADWEIGHT VESSEL IN CONCRETE, WOOD AND STEEL

	Reinforced Concrete	Wood	Steel
Length	125′ 0″	108′ 0″	105′ 0″
Breadth	25′ 0″	23′ 9″	21′ 0″
Depth	11′ 9″	10′ 7″	11′ 4″
Draft bottom of keel aft	10′ 3″ (no keel)	10′ 3″ (keel)	10′ 3″ (no keel)
Deadweight cargo, tons	300	300	300
Cubic capacity of holds and hatchways, cubic feet	17,320	12,350	12,500
Displacement, tons	640	495	455
Time to construct, months	4	8	6
Weight of steel, tons	28½	15	110
Weight of bare hull, tons	290	140	120

The best concrete is the concrete that is the densest; the principal consideration is its permeability. To obtain the necessary density, the cement must be finely ground, the aggregate carefully graded and not too coarse, and the mixing thorough. If the concrete is too rich it is subject to greater contraction and cracks. It is made of cement, sand and aggregate, and for ship work the proportions are usually of 1 to 1½ to 1½ by weight, although the author prefers to specify a mixture of 1 to 3 graded ¼ inch downwards.

The cement usually obtainable is to the British Standard Specification, which provides for a residue on a sieve 180 × 180 = 32,400 meshes per square inch, not exceeding 14 percent.

The steel for the rods is usually of shipyard quality of mild steel 28 to 32 tons per square inch tensile, although

some reinforced concrete experts prefer medium carbon steel (to which category shell discard steel belongs) with 35 to 45 tons per square inch tensile, a contraction of area at fracture not less than 45 percent, to withstand bending cold to 180 degrees, around a diameter equal to twice that of the bar without fracturing the skin of the bent portion.

A minimum covering of the reinforced steelwork with concrete is desirable so as to reduce the weight of the

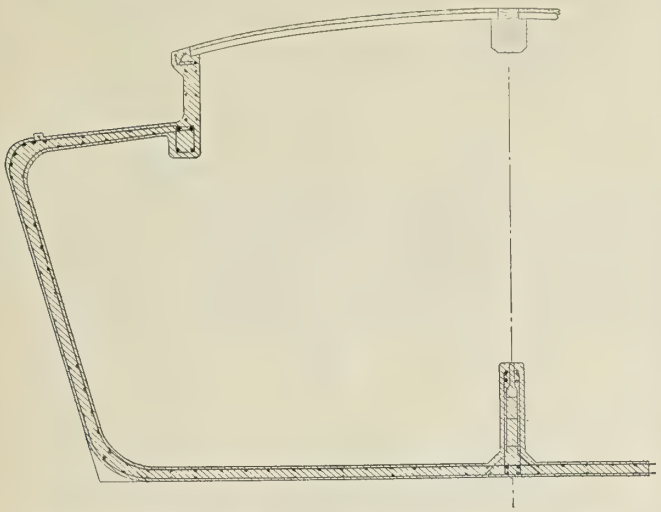


Fig. 10.—Midship Section of Reinforced Concrete Swim Barge (Wells System)

structure, while, at the same time, it must be sufficiently strong to prevent the concrete from breaking away under the torsional and other stresses that a vessel is subject to. For the slab work it will be found necessary to have at least a covering of 1½ inches of concrete over all the bars, floors, frames and keelsons, and where heavy bars are used it is advisable to have a covering of not less than 1 inch of concrete, and even 1¼ inches may be necessary.

The deck may have a granite finish composed of ¼-inch washed granite and cement gaged 2½ to 1, laid at the same time as the under concrete and sprinkled with fine carborundum before the casting is finished. The latest vessels being constructed by the author are having a chequer pattern cast in the finishing coat.

For a 300-ton vessel a 3-inch shell or slabwork will be found sufficient for a 500-tonner 3½ inches, and for a 1,000-tonner 4 inches.

It will be noticed that in Fig. 9 it is proposed to fill a fillet of reinforced concrete under the wooden fender; this fillet could be arranged locally, say 10 feet apart, or continuously all round the vessel in way of the fender, which would enable the construction of an external side stringer to be formed, the inside stringer being consequently reduced.

The section and longitudinal elevation of the 500-ton auxiliary coaster introduce several new features. The vessel having a length between perpendiculars of 155 feet, breadth 29 feet 6 inches, and a depth molded of 13 feet 3 inches is designed on the longitudinal principle, the frames being spaced 8 feet apart. The hold ceiling would be fitted transversely in a vessel of this type, the frames and keelsons being hollowed to reduce weight, and the inside curvature of the shell slabs or panels facilitating the use of light steel shuttering.

The stern frame requires special consideration and design to ensure proper attachment to the reinforced concrete work, especially where a stern tube is fitted. Fig. 2 illustrates the author's patent stern frame, the construction in several pieces being really a war measure and designed to reduce the amount of forged work to a minimum. It will be noticed that the reinforced rods are well connected to the plates and angles. At present it is hardly worth while to make the rudders of concrete, although this is quite possible for large ships; the same remarks apply to masts.

At present the shuttering is of wood; planed, tongued and grooved boards are desirable to obtain a neat fair surface or finish of the concrete work. For a large number of vessels of the same type it would probably be more economical, even at the present time, to use cast iron shuttering. Pressed steel shuttering would have advantages. Then, again, there is a possibility of reinforced concrete shuttering being used.

The prime cost of the finished reinforced concrete work for an ordinary vessel with ship-shaped lines at the present time should average $42 (8/15/0) per ton, made up with the double shuttering at $4.33 (0/18/0) per square yard for timber, and $1.55 (0/6/6) for labor; the concrete at $0.40 (0/1/8) per cubic foot, and the round steel bars from $79 (16/10/0) per ton for the large diameter to $108 (22/10/0) per ton for the small diameters. Vessels with straight lines will cost less, and probably a saving of $4.80 (1/0/0) to $6.00 (1/5/0) per ton will be made, the usual establishment charges and profit being added. These figures are based on a 300-ton deadweight coaster, and for the first vessel only. Larger vessels would, of course, show a reduction.

Taking the hull complete and comparing with steel and wood construction, even if the steel is obtainable at $56.50 (11/15/0) per ton, concrete vessels of the same deadweight should, if standardized, be constructed at 20 percent less cost than a steel vessel and 10 percent less cost than a wooden vessel. The machinery for propulsion will, of course, cost more because of the extra displacement.

With regard to the time for construction after, say, three building berths have been prepared: with ample labor available, and after the first vessel has been cast, the one set of shuttering, so long as it lasts, should enable a barge of 130 tons deadweight to be completed and launched every ten weeks, a 300-ton deadweight coaster every sixteen weeks, and a 1,000-ton deadweight coaster every twenty weeks.

Method of Concrete Ship Construction

BY THEODORE AHLBORN

VARIOUS ships and barges have been built of concrete and steel, the ratio of concrete to steel varying with the different designs. This, of course, is natural, as reinforced concrete is a material only recently adopted for more extensive use in shipbuilding and the effect of the action of high seas on concrete ships is, to a large extent, not well enough known, and practical experience is absolutely needed to determine the weak points in such ships, as stresses will occur which up to the present time could not be determined even in steel or wooden vessels.

In order to produce a design which will take care of any and all stresses known up to the present time, and some which are not known, the writer was guided by the following assumptions:

(1) All steel to be protected by a cover of concrete in no case less than ¾ inch thick.

(2) Structural section, if used at all, to have flat surfaces not more than 2½ inches wide, except main keel, which may have sections having flat surfaces not over 4½ inches wide.

(3) Safe allowable stresses to be used are:
Steel, 15,000 pounds per square inch in tension.
Steel, 7,500 pounds per square inch in shear.

The steel rods are to be welded where possible and plain round rods are preferred.

(6) In sections where there is a doubt that the con-

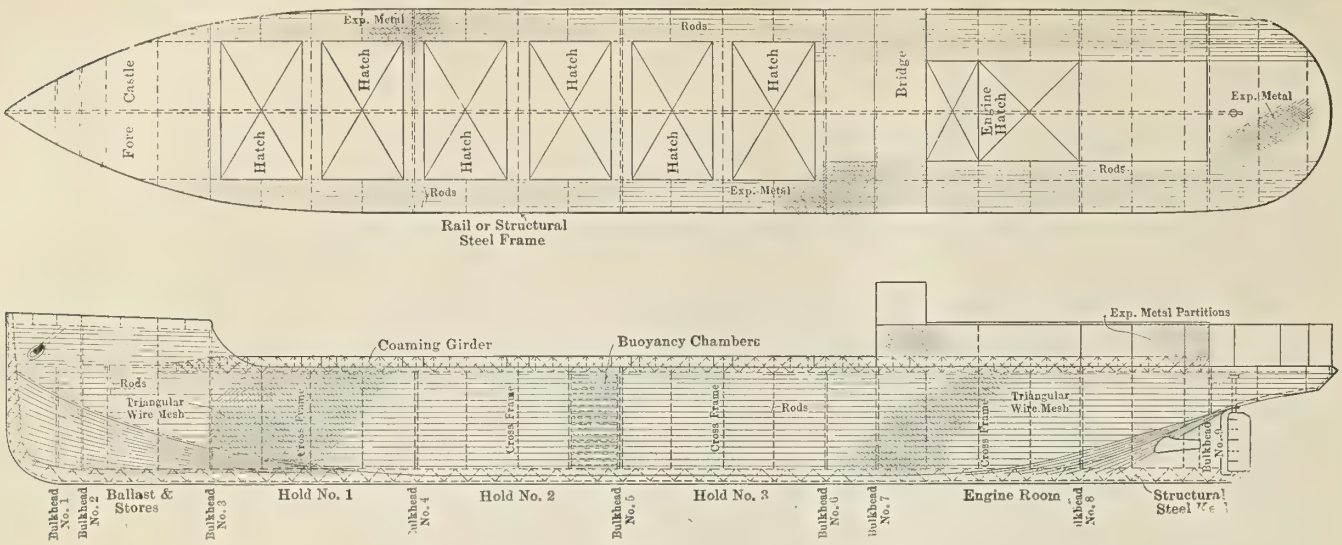


Fig. 1.—Typical Reinforcing for Concrete Ship

Concrete, 750 pounds per square inch in bending compression.
Concrete, 75 pounds per square inch in shear.

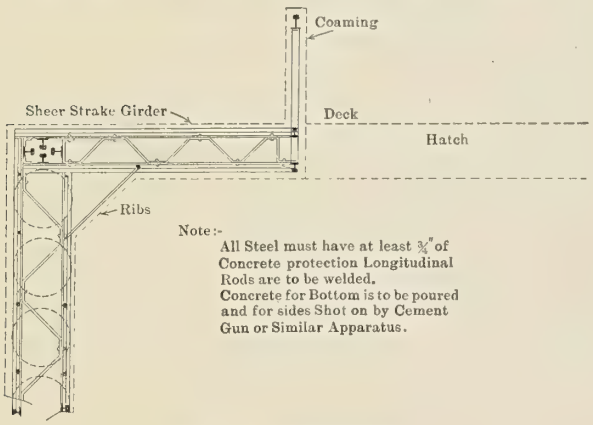

Coaming
Sheer Strake Girder
Deck
Hatch
Ribs
Note:-
All Steel must have at least ¾" of Concrete protection Longitudinal Rods are to be welded.
Concrete for Bottom is to be poured and for sides Shot on by Cement Gun or Similar Apparatus.

Fig. 2.—Hatch Section

(4) The ship's strength is to be calculated for hogging as well as sagging, and the moment WL-35 is to be used for ocean going vessels, WL-40 for lake vessels, and WL-

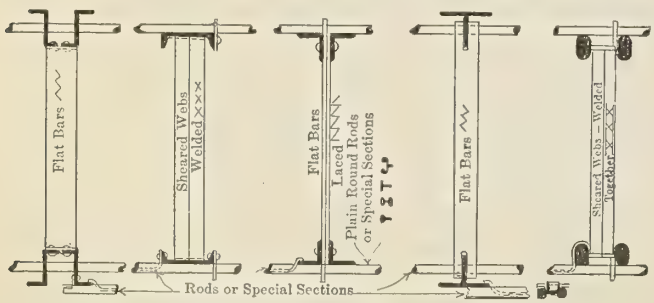


Fig. 3.—Main and Bilge Keel Sections

45 for river and canal vessels; the length of the beam equals the distance between perpendiculars.

(5) All concrete material must be absolutely clean and devoid of vegetable matters, and the sizes should not exceed ⅜ inch in its largest dimension. The cement must be of the highest grade and must pass A. S. T. M. tests.

crete can take care of the possible shearing stresses, the concrete is neglected in figuring and only the steel is called upon to resist the stresses.

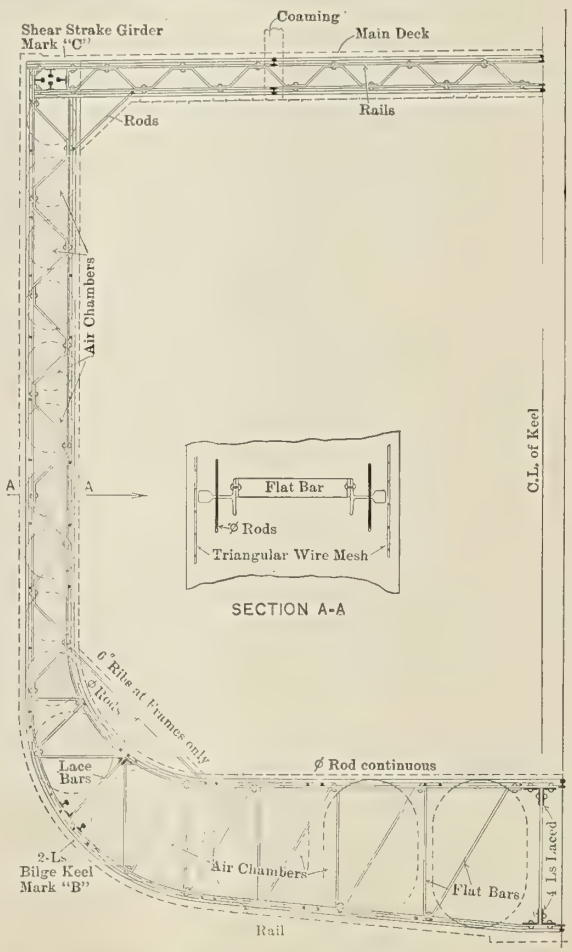


Fig 4.—Midship Section, Showing Reinforcing of Frame

The section amidships is taken as the most important one under consideration and consists of a keel built up out of either angles and bars or rails and bars and is illustrated in Fig. 4. The spaces between sections not less

than ¾ inch wide will permit the concrete to flow freely around the steel, preventing dangerous air pockets. Connecting to this keel are also rail frames spaced from 10 to 12 feet apart. These frames are held in position by bilge keels similar to the main keel and at the sheer strake by a girder section also built up from rails and laced with rods or flat bars. The construction of the bilge keel is shown in Fig. 3 and the sheer strake girder in Fig. 6.

The bottom of the boat is cast between sheet metal forms of No. 30 gage metal, left in place, forming hollow spaces which are used in carrying water ballast, or fuel

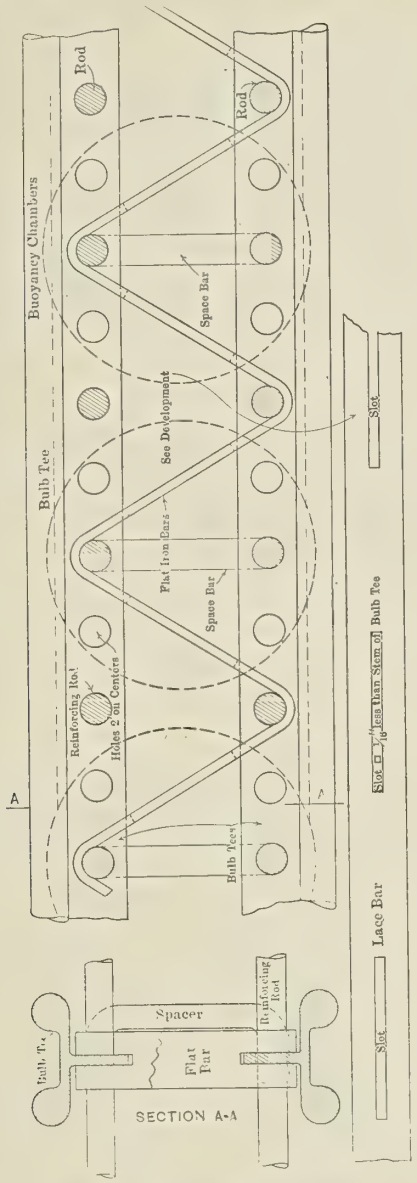


Fig. 5.—Typical Ship Frame Reinforcement

oil, etc. These spaces, called buoyancy chambers, are between transverse bulkheads, spaced from 30 to 40 feet apart, and are connected with the pumps to permit emptying and filling. The sections between the sheet metal forms are T-shaped, a very efficient design using the least amount of material for a given strength. This system is used throughout where possible, with the exception of the decks and bulkheads, which are solid.

Fig. 2 illustrating the hatches shows the coaming used as a section resisting tensional as well as compressional strains and therefore adding considerable strength to the whole design. The sides of the vessel formed by circular buoyancy chambers in the concrete again present a typical T-beam design reinforced with steel in both top and bottom flange. The sides, like the bottom of the vessel, can be designed either as a beam between frames as above mentioned, about 10 or 12 feet apart, or as a beam supported by the bilge keel on one end and the sheer strake girder on the other side.

The way the buoyancy chambers are most efficiently employed is dependent on the depth, load and length of the respective vessels. For long, deep vessels it is more profitable to run all buoyancy chambers in the stem to stern, but in shallow vessels it may prove more economical to run the side chambers from bilge to bilge. Each particular case must be determined separately.

If the hatches are more than 12 feet wide, the frames will be spaced so that there is a complete ring at every second frame; the frame between, being only part of a ring, will stop at the coaming of the hatches. In the latter case the coaming is reinforced to take up the extra strain resulting from the absence of the frame. All bulwark and deck bulkheads, pilot house, galley, crew's quarters, etc., are to be formed by either herringbone or other metal lath, with concrete mortar, either shot or troweled in place.

Methods of Construction

Forms.—After the ways have been laid down (it is assumed that the vessel is to be launched sideways) and the sliding ways are put in place on the standing ways using the proper lubricant (stearine and tallow), the

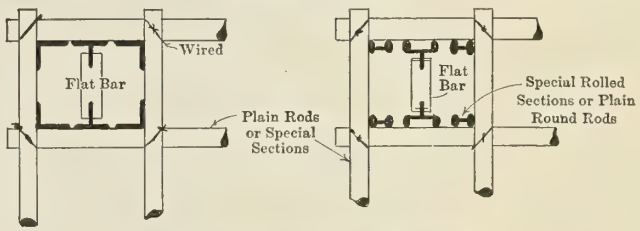


Fig. 6.—Sheer Strake Girder

lubricant is held in place by steel plates to be removed before launching. The forms of the bottom of the ship are now constructed on these ways. Care must be exercised that the keel will receive proper bearings on piles and blocks, using oak wedges, easily removable, but capable of bearing the weight it is necessary for them to support. All these forms must be absolutely watertight and must be so constructed that in no case sagging can occur. Use 4-inch by 4-inch or 6-inch by 6-inch posts on oak wedges placed at proper distances.

Steel.—The forms for the bottom now being in place the erection of the steel is the next step, starting with the keel. The frames, 10 to 12 feet apart, are next to be put in place from the bilge keels, then the sheer strake girder and, last, the balance of the structural steel sections as called for in the plans. The complete skeleton of structural steel being properly riveted together and lined and leveled up, is now ready to receive the bottom re-enforcing, running from to frame, then the sheet metal buoyancy chambers, and on top of this, again, re-enforcing rods running from frame to frame.

Following this the transverse bulkheads are re-enforced, first on one side from frame to frame, then the buoyancy chambers are put in place, and, finally, the re-enforcing for the other side. The same process is adhered to in re-enforcing the sides. The last re-enforcing applied is figured to resist shearing and is run from bilge to sheer

strake girder at an angle of approximately 45 degrees on both sides of the buoyancy chambers of the side walls; and if a center bulkhead is used, on both sides of the chambers of this bulkhead also. The remaining steel reenforcing of the hatch coaming, main deck, etc., forming an integral part of the main hull construction is now put in place; after this is done, no other steel will be erected for the deck houses, bridge, etc., until the ship has been launched.

Concrete.—The concrete for the bottom is to be poured in a continuous operation and enough men must be employed properly to tamp and agitate the concrete so that it will receive its maximum density. This being done the operation of "shooting" the bulkheads with the cement gun should be started, at the same time commencing at the stem and operating two guns on each side of the ship, or six guns altogether.

A continuous process of "shooting" is preferable until the hull, with the exception of the deck, has been completed. The surfaces should be troweled smooth and glass hard by experienced cement finishers. Three days after the "shooting" has started the carpenters may begin to place such forms as are necessary to support the main deck. The re-enforcing being in place the concrete can then be started, using the pouring method as soon as sufficient space is available. It is most important that all sleeves, inserts, fittings, bolts, pipes, hawse pipes, bollards, etc., are in place before concreting is started.

All outside forms are to be removed before launching. The hull should be carefully inspected, on both sides and bottom, and if places are noticed where, because of leaking of forms, or for other causes, rough places occur, these are to be washed out with clean water and then a very good mixture of cement and sand must be shot in place and troweled hard so that the entire hull with have a neat, smooth surface. This being completed the dog shores holding the sliding ways are put in shape. The steel plates under the sliding ways are then removed, so that the ship is resting on the greased ways proper and is ready for launching.

The lower ends of the sliding ways are also greased preparatory to letting the ship down on the sliding ways in its cradle, with only two dog shores holding it. The temporary struts holding the shores in place can now be removed. The dogs are knocked out simultaneously by means of suspended weights held by triggers connected by a cord to be cut with a knife.

All points being observed the vessel should be launched in about twenty seconds.

Developments in Concrete Barges and Ships*

Brief Resume of History of Concrete Shipbuilding—What Has Been Accomplished in the United States and Abroad

BY J. E. FREEMAN†

IT has generally been considered that the earliest use of what is to-day known as reinforced concrete was the concrete garden tubs constructed by Monier in the 1850's. But it is a fact that an earlier development in boat building by the use of cement mortar on a framework of rods or mesh was utilized by M. Lambot in 1849 in building his historic craft, the first concrete boat of which we have record. This boat was exhibited at a World's Fair in Paris in 1855 and was still seen in successful use as late as 1903.

This general method of cement plaster construction developed further in Holland, when a small sloop, the *Zeemew*, was constructed in 1887, to be followed in more recent days by barges of 50 or 60 tons capacity, many of the open hull type which are used on the Dutch canals for handling sand and gravel or disposing of ashes and other refuse. The *Zeemew* was reported last year in the possession of a ferro-concrete company at Amsterdam, still in good condition despite the fact that it had been in quite a number of collisions and had repeatedly been hauled up a stone embankment and frozen fast every winter. One writer says it has been used many years for duck hunting in small bays, etc.

A recent article on the Holland work in Concrete and Constructional Engineering (London) contains this interesting statement—"Careful examination of two concrete boats which had been in regular use for seven and eight years, respectively, showed that no growths occur, if the surface of the concrete is smoothed before launching. If the surface is left very rough, barnacles or algae may adhere to it. The smoothly finished concrete also reduces the skin friction of the vessel when moving through the water....."

A concrete pontoon serving as a landing stage for ferry-boats at Sydney, N. S. W., has seen severe service since 1914. During the discussion following a paper on concrete ships at a meeting of the Engineering Association of New South Wales last July, some interesting information regarding this pontoon was given by an engineer evidently connected with the Harbor Board, who said: "It measures 110 feet in length, 60 feet in width at one end and 70 feet at the other, the depth being 7 feet 9 inches. It has about 3 feet 6 inches of freeboard and displaces 783 tons. It is divided into 44 watertight compartments, firstly, to provide against the liability to be sunk by collision and, secondly, to stiffen it to withstand the continual shock of the ferry-boats when berthing. The sides, bottom and deck are 5 inches thick and doubly reinforced; the bulkheads are four inches thick, and also doubly reinforced.

"This being the first of its kind built here and one of the largest afloat at the time anywhere, no risks were taken, and it is perhaps stronger than future experience may warrant. It is not a ship; it has to stand more severe usage than a ship would ordinarily experience, owing to the severe shocks often given by large ferry boats, which continue day after day to bump it while berthing."

We are all more or less familiar with the Italian barges built by Carlo Gabellini, among the early examples of which was the *Liguria*. Many concrete pontoons from the Gabellini yards have been built for bridges across the Po and other Italian rivers, and have required little maintenance though subjected to shocks from both ves-

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† Portland Cement Association, Chicago, Ill.

sels and ice. Doubtless this same yard had much to do with the construction of the concrete barges that are now being used by our Italian Allies for mounting naval guns of large caliber used in the defense of the Piave river line. Here is certainly good evidence of the strength of concrete under heavy shocks and vibration.

Our own country possesses to-day an interesting example of the Gabellini type of barge. In 1912, a group of men in Mobile built a barge about 90 feet long, 26 feet wide and 9 feet deep, bringing over from Italy several engineers to supervise the construction. Doubtless owing to unfamiliarity of the owners with boat building and of the engineers with American conditions, this first craft was rather expensive and discouraged further operations, the barge remaining the sole example of their work. The barge was used for several years in handling coal, sand, etc., on the river, until driven ashore in a severe storm late in 1916, at which time a hole was punched in the side by a projecting pile or some such obstruction. Early this year the barge was repaired at small cost and turned over to a shipbuilding company at Pascagoula, Miss. The barge, though originally handling a deck load mostly, has now been carrying fuel oil in the hold—good evidence not only of the success of repairing concrete barges but of the practicability of concrete barges for the carrying of oil cargoes. This is all the more interesting in view of the present plans of the Shipping Board to construct a number of concrete oil tankers of 7,500 tons capacity and the projects of several private interests for a fleet of oil barges for the Mexican oil trade. Satisfactory results in the storage of fuel oil in concrete tanks and the greater knowledge now possessed of the requirements of concrete boat building make successful results all the more certain.

Concrete Barges

Concrete barge building has now been revived in the South—the first products being the two 550 ton barges that have been built by the J. W. Thompson Company near New Orleans, one of which is now in commission. These barges are 130 feet by 30 feet by 7½ feet at the center and 8½ feet at the rakes, drawing 2 feet 7 inches when light and 7 feet when loaded. Mr. Thompson in commenting on the first barge placed in service said:

"Concrete barge *Mila No.* 1 with 450 tons gravel made her maiden trip yesterday. She showed no leaks at all. Handled better at loading dredge and towed steadier than our wooden barges. I vote her a real success."

Interesting progress photographs have been received of the 500-ton concrete barge being built by the Interocean Barge & Transport Company, at Seattle, and give a good idea of the general type of construction and arrangement of interior framing, reinforcement, etc. This barge is 116 feet by 34 feet by 10 feet in general dimensions with a load draft of 8 feet. The hull is divided into watertight compartments by one longitudinal and four cross bulkheads. These are 4 inches thick, while the sides, bottom and deck are 3½ inches. The barge has a weight of 350 tons, which gives a ratio of deadweight to displacement of about 60 percent. Concreting is now completed after continuous operation from start to finish with the exception of a break at the deck line where a joint was made. It was reported that after over one hundred hours' continuous placing, the concrete gang stopped for five minutes to cheer the good ship *Faith* as she steamed up to Seattle on her maiden voyage—certainly a sufficient excuse for a few moments' delay.

In the East the 700-ton barge built by the Louis L. Brown Company has been launched, and other barges are now being built for the Navy Department, while there is every prospect of a large number of barges of this kind being built for service on the Erie Canal and other inland waterways. Concrete barges have proved their usefulness. The 200-ton *Pioneer,* built in 1910 for use on the Welland Canal, is still serving just as efficiently as when new, and has been subjected to severe tests. The barge has been loaded many times with carloads of rubble stone dumped from a height of 12 to 15 feet upon the concrete deck, the full load starting from one end, which procedure would doubtless make an oldtime wooden scow captain shiver. Answering a question recently in regard to the effect of loading stone thus, J. L. Weller, the designer and builder, has said: "The deck of the *Pioneer* is of 2½-inch concrete and has never been protected or covered in any way while stone was being dropped upon it. In probably half a dozen cases where a large stone dropped on its corner a dent was made on the surface; but this did not amount to anything and apparently has been patched up, as they are not noticeable, and the deck is now 99 percent, at least, in as good condition as when built."

The need is great for river barges to handle coal. About 50 percent of the wood coal barges used on the Ohio River for this purpose were lost in the ice jams last spring. We have given some study to this problem and have worked out a tentative design for a 500-ton concrete barge that may be of interest to those studying the same subject. The displacement loaded is 680 tons, giving a ratio of deadweight to displacement of 70 percent.

The barge has the same length and breadth as the wooden barge—i. e., 135 feet by 26 feet—and a slightly greater depth and is intended to be used in the fleets or separately as required. Results of experiments made by the Government and published in a bulletin "Experimental Towboats" indicated that for the draft and conditions under which this barge would be used the circular type of rake offered the least resistance in towing.

Brackets and cross beams 9 feet apart support the shell and top beams; but the brackets project only 2 feet inside, which should interfere little with loading or unloading. There are also longitudinal beams in the bottom, which is a double bottom for extra safety against sinking if the bottom is damaged and gives extra stiffness also. The shell is 2¾ inches on the bottom, decreasing to 2 inches at the top. The draft is 22 inches light and 6 feet 7 inches loaded (concrete 155 pounds). With the use of lighter weight concrete this could be reduced.

The floor might be cast with the rest of the barge or made of pre-cast sections placed later, thus simplifying forms, a wedge-shaped space left between the edges of adjacent slabs over the beams containing strap iron anchors, which, when encased in the concrete filling the wedges, hold the floor slabs securely. The wedges could be cut out when necessary to replace individual sections, the edges of the slabs being coated with tar.

A barge somewhat similar to this type has been used on English canals for handling ashes, etc.

Progress in England and France

England and France are making great strides in the construction of barges and lighters, many of them for sea-going service and others for the various canals and waterways. A good example of what a standard design and standardized forms can accomplish in the way of speed of construction is found in the yard of a French company located on the bank of the Seine. Here as many at 10 lighters about 125 feet long are under construction at a time, and production is said to average one vessel a week. The forms have been carefully designed not only to give the craft graceful lines but to facilitate assembling

and taking down, and, of course, are used repeatedly. It is stated that about 10 days' time is required to set the forms and place the reinforcement and 2 days to place the concrete, working continuously. After forms are removed the surface is smoothed by rubbing. When the craft is to be launched a large crane picks it up bodily and places it in the water. This crane also serves a useful purpose in handling forms, etc.

T. J. Gueritte, the French engineer whose paper on concrete boatbuilding was published in the June issue of MARINE ENGINEERING, says: "The author has seen in what was 4 months before a bare field two 1,000-ton barges ready for launching and several others following closely." He further makes the interesting point that with concrete, alterations in the design in course of erection can be readily effected in building both barges and ships of concrete, which undoubtedly has its advantages in some cases.

James Pollock and Sons Company, of London, have adopted the use of straight lines wherever possible for the small coasting vessels now building, to simplify formwork, but the J. & B. Stewart Company of London and Belfast, which has completed recently a sea-going barge, followed the usual ship lines. The vessel was apparently constructed in a dry-dock or slip and launched by filling the dock, which is somewhat the same procedure as has been proposed by some in our own country.

The 125-foot concrete ship built by the Atlas Construction Company, of Montreal, and launched last November, is practically ready for service. This vessel is interesting because of the use of structural steel frames which were encased in concrete at the time the concrete shell was cast.

Work in Norwegian Yards

The Norwegian yards, which were among the first to build concrete ships for ocean service, are continuing their activities. The Fougner yard at Moss completed in March, a 600-ton motor ship similar to the *Namsenfjord*, which is well known to shipbuilders, and is following this with 1,000 and 1,500 ton vessels, while the Fougner American yard is at work on concrete barges and several 3,500-ton ships. This company built the first floating drydock of reinforced concrete last year for a Christiania firm of yacht builders, the dock accommodating a vessel 75 feet by 25 feet and having a lifting capacity of 100 tons. The application of concrete to a floating structure of this kind is particularly interesting in view of the need for many floating dry-docks in connection with our rapidly expanding merchant marine. I understand that a company in San Francisco has about completed another floating dry-dock of concrete which has a capacity of 6,000 tons.

The Porsgrund Company, of Porsgrund, Norway, has also another lighter nearly complete similar to the 200-ton vessel launched last July, which is unique in that it was constructed and launched bottom up. The vessel was righted in the water by an ingenious arrangement of inner compartments whereby water was admitted to certain compartments, while others remained filled with air, thus anbalancing the craft so that it slowly turned over until it floated in correct position.

Concrete Steamer Faith

But it has remained for America to take the lead by the construction of the 5,000-ton concrete cargo steamship *Faith* on the Pacific Coast, and demonstrate that concrete was practicable for ocean-going vessels of large tonnage. It is tonnage of this class that we need now—this year—which by reinforced concrete construction can be supplied quickly and without interference to the construction of wooden or steel vessels.

Our lead should be maintained and a comprehensive programme of concrete ship construction vigorously prosecuted. The attitude of our English Allies toward this matter is strikingly emphasized in a remark of one of the Admiralty officials concerning concrete ships, that "Every encouragement is being given by the Admiralty; newly formed yards have been laid down specially, while existing shipyards have been encouraged to form branch establishments for the purpose."

When the construction of this vessel was begun in September, 1917, many were beginning to realize the magnitude of the shipping problem, but few had given thought to the possibilities of concrete construction in solving that problem. The construction has been quite generally described in print and will be shown in the motion pictures, so I shall not dwell on that here.

The shipping problem had become more fully understood by the time the vessel was launched on March 14 and chirstened *Faith*, and the success of this launching attached greater interest and importance to the concrete ship.

Early in May the *Faith* was completely fitted out ready for her trial trip—a record for such work on the Pacific Coast—and during the trials developed more than the designed speed of 10 knots which it was estimated the 1,750 horsepower engines would give.

The latter part of May the *Faith* took on her first cargo, salt and copper, and a few days later sailed for Vancouver via Seattle and Tacoma.

The maiden voyage of the *Faith* was as strenuous and severe a test as could be asked for in a concrete ship and she stood up under the gale, which at times put the decks awash, in splendid fashion, reaching Seattle—her first port of call—6 days after leaving San Francisco, in excellent shape, having taken in no water through the bottom.

Faith in concrete has again been justified. The application of a tried material to a known problem has again been accomplished. Concrete ships must be built in large numbers and with all possible speed to help answer the call for ships, more ships and still more ships, and win the war.

New Organization Formed to Boost Building of Concrete Ships

A NEW organization, the International Concrete Ship Association, composed of engineers and business men from all parts of the country, has recently been founded with a view to developing a practical working plan for building concrete ships to be utilized in aiding the overseas transportation problem. With ample capital, recognized engineering skill, and labor and shipway facilities at their disposal, the association proposes the building of 500 large reinforced concrete and steel ships, together with innumerable river, lake and canal craft, sixty percent of the tonnage of which it proposes to offer to the government at government rates. The capital of the component corporations and individuals is said to run into billions of dollars and their plants spread over the entire country.

Personnel of the Organization

The character and standing of the men who compose the association are sufficient endorsement for its potential efficiency. The board of consulting engineers includes such men as Theodore Ferris, naval architect, of New

York, Esplin Sons & McKnaught, Maurice Deutsch, Harold P. Brown, consulting and contracting engineer, and Alexander Brociner, New York. Victor C. Coxhead, from the state of Washington, who is chairman of the general committee of the association, represents eighteen interested companies in Puget Sound, four Eastern shipbuilding yards, and four Canadian shipbuilding companies; he is also a member of the War Industries Committee of the Pacific coast and has direct charge of the coast west of the Cascade Mountains. Mr. Coxhead has come East to give his entire time to this proposed concrete ship fleet, working from the association's national headquarters, 7 East Forty-second street, New York, and from room 470, Woodward Building, Washington, D. C., in conjunction with John W. Clifton, counsel of the association and its general representative at the capital.

The executive committee of the association is composed of R. C. Morris, of New York, chairman; Guy Vroman, of New York, formerly engineer of the Catskill Aqueduct; Maurice Deutsch, consulting engineer for a number of Eastern companies; John F. Pell, representing several concrete shipbuilding companies, and Albert Oliver, of Albert Oliver & Son, general contractors of New York.

Others who are giving their time to the details of the work are Robert F. Hall, well known in connection with the Portland Cement Association and now general manager of the Lime Association of the United States, cement representatives of the largest concrete producers, manufacturers of concrete making machinery; concrete material men and numerous individuals throughout the States who are connected with the concrete industry, naval architecture and allied engineering.

Feasibility of Concrete Ship Construction

At the founding meeting of the association held in New York on July 24—at which H. J. Brunnier, of the Emergency Fleet Corporation, representing Mr. Schwab, and Captain Robinson, of the Government Transport Department, were present—Frank Van Vleck, appearing as General Goethal's representative, said:

"I can say on behalf of General Goethals that he is very much interested in the reinforced concrete ship, and he is willing to back up his reputation, as the builder of the Panama Canal, where reinforced concrete made the building of it possible—he is willing to back that reputation on the building of concrete ships, and with that in view he has asked the Transportation Department of the War Department definitely to commit themselves in regard to concrete boats.

"We have already let contracts for some twenty-five concrete vessels, and we are to open bids in a few days for concrete barges, and we are designing other vessels that may go up as high as seven thousand tons. The general feeling in all these cases is that it is simply a matter of good design, of good construction, of good naval architecture, and results can be accomplished which will help to solve the problem.

"In other words, the War Department has committed itself to a policy of not placing contracts for vessels—wood, steel or concrete—in any yards which are doing Shipping Board work or navy work. That being so, it almost inevitably drives the War Department into the yards of new contractors, who are willing to start on almost nothing and are willing to entertain concrete or other unusual methods of construction. As a war-time measure, it feels perfectly justified in going ahead and encouraging contractors in undertaking these new things."

The recent statements of R. J. Wig, chief engineer at the head of the concrete division of the United States Shipping Board, declaring that recent tests of concrete structures in sea water have shown that they will last years without any protection whatever, come from an unprejudiced expert. He has also stated that few people realize that the concrete ship is actually 20 percent lighter than the wooden ship, if built of a new concrete mixture developed by the Emergency Fleet Corporation. "It is so light, in fact," continues Mr. Wig, "that a block of it floats on the water, and yet it makes the kind of concrete possessing twice the strength of that used in ordinary building construction."

The members of the association, men who have had long experience in every branch of the concrete business, believe that reinforced concrete offers the solution of the shipbuilding material problem. They assert that they can begin work at once without interfering in any way with any of the government shipbuilding plans. The association points out that structural steel is not used in the concrete ship, so the building of the proposed fleet would not interfere with government plans for steel ships; also that the only steel which enters to any extent into the construction of a reinforced concrete ship is bar steel, of which there are now on hand in warehouses sufficient quantities to build 13,000,000 tons of concrete ships.

Future Developments

The association's data, issued by its secretary, H. F. Cuntz, on August 1, shows the following permits for concrete craft construction:

Firm	Vessels	Date
Universal Shipbuilding Company, Sturgeon Bay, Wis.	12 reinforced concrete barges 1,500-2,500 tons deadweight and 6 barges 1,000-2,000 tons deadweight.	1918 March 7
J. L. Weller, Tonawanda, N. Y.	30 reinforced tow barges, 575 tons deadweight.	May 8
Concrete Steel Shipbuilding Company, Savannah, Ga.	1 concrete freighter and 1 reinforced concrete barge 500-600 tons deadweight.	May 24
S. S. Saxton Company, Chicago, Ill.	5 concrete tankers 3,500 tons deadweight.	May 25
Concrete Shipbuilding Company, Newburgh, N. Y.	4 reinforced concrete capsule shape 2,500 tons deadweight.	May 27
Delta Shipbuilding Company, New Orleans, La.	12 1,000-ton river barges.	

This building, totaling only approximately 83,750 deadweight tons of concrete craft, includes ten motorships and sixty-one barges for river and ocean service.

This record should show, the association claims, 750,000 tons by September first and at least 2,000,000 tons by October first.

Besides the above, the government has let contracts to five yards for eight 7,500-ton ships each, which alone totals 300,000 tons to be built at yards in San Diego, Cal.; Mobile, Ala.; Wilmington, N. C.; Jacksonville, Fla.; San Francisco, Cal.

The immediate utilization of the $50,000,000 (£10,250,000) which the government has already appropriated as an *emergency* fund to build concrete cargo hulls would, the International Shipbuilding Association believes, go far toward supplying the twelve to fifteen million tons of ocean transport needed for adequate service. The members of the association hope that the result of their concentrated efforts will be to make it possible for the Emergency Fleet Corporation and the War Department to accept their assistance and capital to build up a great future for the American merchant marine.

An eight-inch periscope is a very small percentage of the Atlantic Ocean. Remember the fact when you tell your friends the United States Navy ought to sweep the ocean free of submarines.

Fig. 1.—Class of House Carpenters Attending Night School in Newburgh to Obtain General Knowledge of Ship Construction

Overcoming the Labor Problem at the Newburgh Shipbuilding Company Plant

Home Labor Utilized by Efficient Training in Night School Courses—Instruction Continued in the Shipyard

(Photographs Copyright by Publishers Photo Service, N. Y.)

WHEN the Newburgh Shipbuilding Company began operation at Newburgh, N. Y., in the winter of 1917, the organizers were confronted with the difficult problem of securing efficient shipbuilding labor from a depleted market. Labor of this class had long since been drawn at high wages by competing yards. The company tackled the task in true Yankee fashion.

Like many Eastern inland cities of 35,000 inhabitants, Newburgh engages in varied industrial pursuits within her borders and also draws capital and trade from the surrounding agricultural district. Shipbuilding, however, was a new industry. To meet the situation, it was planned to select the more efficient and more ambitious workmen from the home market, by using the attractive wage and patriotic appeals, and to train these men to the varied tasks of the shipbuilder. Shipbuilding night schools were organized under the regular city night school system and were conducted as a part of it. When the lists were opened for enrollment in the early part of the winter, the great number of applicants made it necessary to establish four classes, each class receiving two evenings' instruction during the week. This arrangement kept many applicants upon a long waiting list, and even at present the enrollment in the shipbuilding classes far exceeds the total enrollment in all other classes in former times.

Two separate courses are given. The first is essentially practical. Inexperienced men are taught riveting, chipping and calking from the simplest operations up. These

Fig. 2.—Instructing Shipfitter Students How to Make Templates on Ship Under Construction

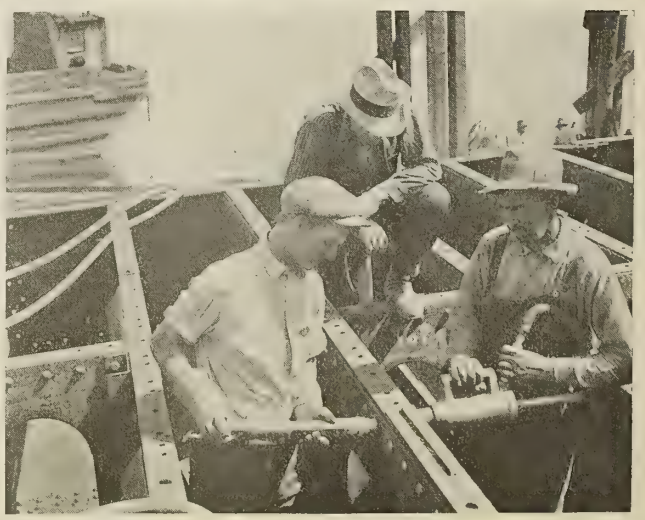


Fig. 3.—Men Riveting on Ship Under Supervision of Trained Mechanic After Receiving Night School Training

Fig. 4.—Shipfitters Applying Knowledge Gained in Night School to Actual Work in Shipyard

Fig. 5.—Heater Boys Learning to Heat Rivets Under Supervision of Instructor

Fig. 6.—Making Templates from Lines on Mold Loft Floor

Fig. 7.—Constructing Mold for Furnaced Plate

classes are conducted in the basement of the school building with regulation pneumatic tools. Compressed air is supplied by a small compressor plant. Under the supervision of instructors the men work on iron boxes, which are later used in the shipyard for storing small parts. Everything the men do, from the time they first touch a tool, is practical constructive work. Each product is

Fig. 8.—Calking Deck Seams

utilized. Every rivet driven is helping the shipbuilding programme. This fact alone gives the men a great interest in their work. The men enrolling in these classes are usually a husky and hardy lot, accustomed to heavy manual labor. Many farmers have become riveters and prove to be the most useful workmen. One farmer walked several miles to school every night after completing his regular farm work during the day. He soon finished his course and was put to work on the ship, where he is now driving more rivets per day and making more money than old-time riveters working beside him. His wages run from $60 to $70 (12/10/0 to 14/11/8) a week, a rate above the general average wage. Other trades which are drawn on for riveters are stone masons, blacksmiths, stevedores, bargemen and brickyard employees.

At present the period of night school instruction extends over three weeks. At the end of this time the men who show most aptitude in the class are put in the shipyard under an instructor and paid at the rate of forty cents (1/8) an hour. Those remaining in the class continue their night work, and when they show sufficient proficiency are taken on, provided the work in the yard warrants new employees. The yard has a group of teachers—men who have taken the instruction course in the government shipbuilding school at the Shipping Board Training Center in Virginia. Each instructor has four to eight workmen under him. He does no work himself, but closely supervises every move of his pupils. Every rivet which a pupil drives is real work accomplished—not mere practice on extra material. When the student goes on a ship every rivet which he drives in the hull will remain as long as the ship is afloat. After three or four weeks' work on the hull under supervision, the workman is graduated and receives the regular government scale of wages.

The second course, known as the "Ship Information and General Construction Course," gives carpenters, steamfitters, electricians and men from allied trades a general comprehensive knowledge of the form, construction and names of the different ship parts, so that when they go down to work on the ship and are told to go into the forward hold they will know at once where to go. The men who take this course are usually skilled mechanics. They need only the new language and new application of well-learned facts to be converted into shipbuilders. This advanced course also includes mechanical drawing and blue print reading, which is essential to the mold loftsman and the ship framer.

The men who have been carpenters before, and who have completed the second course, are at once used as ship framers and work in the mold loft. The system of supervision, graduation and payment is essentially the same as for the riveters.

It is interesting to note that the personnel of the Newburgh shipyard is far above that usually found about shipbuilding plants. The men are quiet, clean, sober and industrious, each intensely interested in his work, and each apparently having a higher and broader outlook on life than the pay envelope gives. They work with an earnestness and industry which speak well for the shipbuilding night school course.

Training Workers for Wooden Shipyards

New Course of Instruction Organized at Pratt Institute, Brooklyn, N. Y., for Woodworkers in Shipyards

A NEW course of instruction has been especially organized by Richard M. Van Gaasbeek, head of the woodworking department in the School of Science and Technology, Pratt Institute, Brooklyn, N. Y., to serve in the present national need for increased productive efficiency in the shipbuilding industry by aiding in supplying the extraordinary demands for skilled ship workers arising from the war.

Extent of Instruction

The instruction is arranged to give to house carpenters and other skilled woodworkers a practical understanding of wooden ship and boat building, including also woodwork on steel ships, with a view to helping such men to become competent workers in the great shipbuilding industry now rapidly developing in this country. The course is open only to experienced woodworkers in the trades mentioned, and is intended to be taken either just before or just after transfer to shipwork. The school is in a position to assist men taking in this course to obtain employment in ship and boat building yards.

Outline of the Course of Instruction*

The experienced ship woodworker who wishes to broaden his knowledge of modern wooden ship and boat building practice will find in the advanced term of this course instruction well suited to his requirements.

It has been the aim to establish a fundamental course that will help the shipbuilder as well as the boat builder;

* The facts in this portion of the article are taken from a paper by Richard M. Van Gaasbeek, appearing in the current issue of *The National Marine*. Photographs by Publishers Photo Service, N. Y.

Fig. 1.—Picking Up Lines from Mold Loft Floor

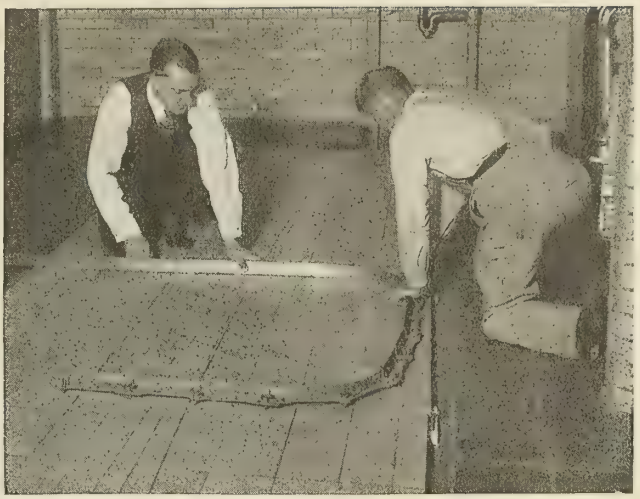


Fig. 2.—Picking Up Lines with Flexible Steel Template

Fig. 3.—Students Practicing Light and Heavy Calking

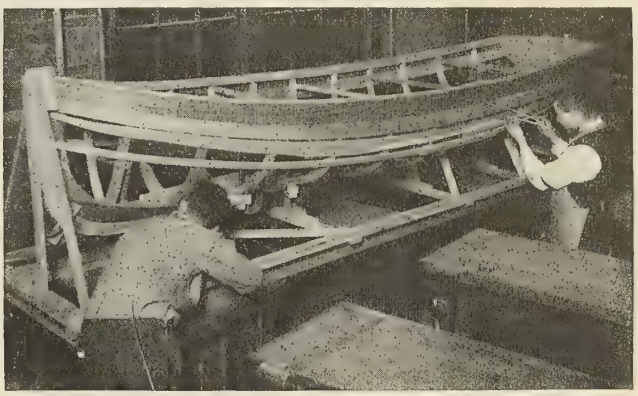


Fig. 4.—Spiling for First Lower Strake of Planking

for whatever may be the size or type of the vessel under consideration, the general principles of construction remain very much the same in all cases. To build a full size ship was out of the question. The cost of the lumber, the space and equipment necessary to handle the heavy timbers, the extra heavy work that would be required of the men after a hard day's work, and the length of time it would take to complete their training are factors that had to be considered in selecting a problem that would meet the emergency situation.

Since laying down the lines of a vessel on the mold loft floor calls for a knowledge of the principles of descriptive geometry not possessed by the average mechanic, Mr. Van Gaasbeek does not believe that the proper place to begin the training of a new recruit to the boat or ship building industry is in the mold loft. The lines of the vessels that have been laid down on the mold loft floor in Pratt Institute have all been laid down as a class problem under the direction of an instructor, with no special effort made to have the student thoroughly understand the lines during the preliminary period of his training. Later, when the students have picked up their lines and made their molds and applied them in the construction of their problem, their minds are more receptive and they can absorb and understand the principles as they are presented by their instructors. At this later period emphasis is then placed upon principles rather than construction.

Basic Principles Taught

Accordingly, two men are assigned to each side of a boat and begin their training with the picking up of the lines from the mold loft floor and the making of their molds through to the completed boat.

Special instruction and practice work is given in sizing and scarphing heavy yellow pine timber, calking (both light and heavy work), and steam bending of materials. The shop is equipped with a modern mill plant of woodworking machinery, including joiners and surface planer, circular and band saws, mortise and tennon machines, jig saw and boring machines—all motor-driven. Also sixty benches, each with a complete outfit of hand tools.

Each student is taught to get out his stock from the rough timber to the finished product, and those who master this course are qualified to direct the labor of others because they have learned by doing. It is by manipulative skill that a practical understanding can best be acquired.

This course is not only recommended to carpenters and other woodworkers who are transferring to the boat and ship building industries, but is also advised for those already in the industries who have, because of circumstances, been compelled to specialize in one branch or another and now wish to broaden their knowledge of

wooden boat and ship building practice in order that they may take advantage of the many opportunities that are now being offered. The course is designed to help and is equally valuable to men working on steel ships who wish to study the underlying basic principles of ship construction in order that they may prepare for greater responsibilities.

Parts of Vessel to which Application of Electric Welding Has Been Considered and Approved by American Bureau of Shipping and Lloyds

ALTHOUGH the classification societies are proceeding very cautiously in approving the application of electric welding to new ship construction, because of the lack of a reliable system of testing the quality and strength of the welds, nevertheless both the American Bureau of Shipping and Lloyds now approve the welding by electricity of the following parts of steel vessels:

Deck rail stanchions to plating.
Clips for detachable rail stanchions.
Continuous railing rods (joints).
Attaching deck collars (L rings) around ventilators.
Attaching deck collars (L rings) around smoke stack.
Attaching cape rings around smoke stack, pipes, etc.
Attaching galley fixtures to plating.
Attaching bath and other fixtures in officers' quarters.
Attaching cowl supporting rings to ventilators.
Bulwark rail top splicing and end fitting.
Skylights over galley.
(*a*) Engine room stairs and gratings.
(*a*) Boiler room stairs and gratings.
Attaching (*a*) and (*b*) to plating grab rods on casing.
All stairs and ladders, including rail attachments.
Door frames to casing, hinges, catch holds, coach-hooks, etc.
Clips for attaching interior wood finish to casing.
Entire screen bulkhead.
Coal chutes.
Butts of watertight and oiltight boundary bars on bulkheads or floors in double bottom.
Ventilator cowls.
Stacks and uptakes.
Bulkheads (that are not structural parts of the ship), partition bulkheads in accommodation.
Framing and supports for engine and boiler room flooring or gratings.
Cargo batten cleats.
Tanks (that are not structural parts).
Shaft alley escapes.
Steel skylights over accommodation spaces.
Engine room skylights.
Grab rods on exterior and interior of deck houses.
Deck houses not covering unprotected openings through weather decks.
Reinforcing and protecting angles around manholes.
Joints of watertight angle collars at frames in way of watertight flats.

The undertaker's friend is the man who "did not think" or who thought the job "was good enough." It is a great temptation when crews want to get ashore to slight the repair job. Don't do it; it may mean your life or that of some one else later.

Handy Method for Laying Off Tank Margin Plates

BY J. A. RIDLEY*, NAVAL ARCHITECT (SOUTH KENSINGTON)

THE following method, original as far as the writer is concerned, seems particularly applicable to the standard type of cargo steamer now being built on the Great Lakes for the Emergency Fleet Corporation, owing to the simple arrangement of the margins with the same slope throughout and being straight lines along the knuckle from butt to butt.

I am assuming that all who are interested in this article will have a general knowledge of fairing up the lines of a ship and that the margins are already marked in place on the body plan as usual for templating frames, floors, etc.

In every method you will have the inboard bend or knuckle line produced in the half breadth plan, i. e., straight from butt to butt, and I propose to hinge the margin plate at this line and swing up into the expanded or true shape in the half breadth plan.

You will first project the outboard edge of the margin in the half breadth plan by measuring on the body plan the half breadth of this edge at each frame section and placing these on the same frame sections in the half breadth plan and drawing a line through the spots.

If you now mark on the floor the inboard edge of the plate, including the lap and butts on the tank top, you have a complete projection of the margin in view, in direct connection with the tank top, handy for marking both together.

You now take on record the girth or width of each margin on the body plan from the tank top to the frame line. It is a good plan also to record the vertical height of each margin for a check on the former.

Next, to lay off the plates on the half breadth plan, tack a straight edge to the margin knuckle as shown, and with a square produce a line through the intersection of the frame and the outboard edge of the margin long enough to take *E* the width of margin at that frame, which width can now be applied from the straight edge at the frame intersection, giving a point for the true shape of the outboard edge of the plate. A line through this to the point at the straight edge gives the true frame line at that station.

Repeat this operation at each frame and also at the middle line of butt.

A good way is to find the outboard spot *D* first by using the vertical height check *A* referred to and then place the square in the position shown. Put the vertical height on for leg *A*, then take the hypotenuse or length *C* and place it along the other leg *B* to *D*, giving a spot which equals or checks the previous one explained.

The last method mentioned is used particularly at the middle line of butt, the vertical height in this case being the one taken from the nearest frame.

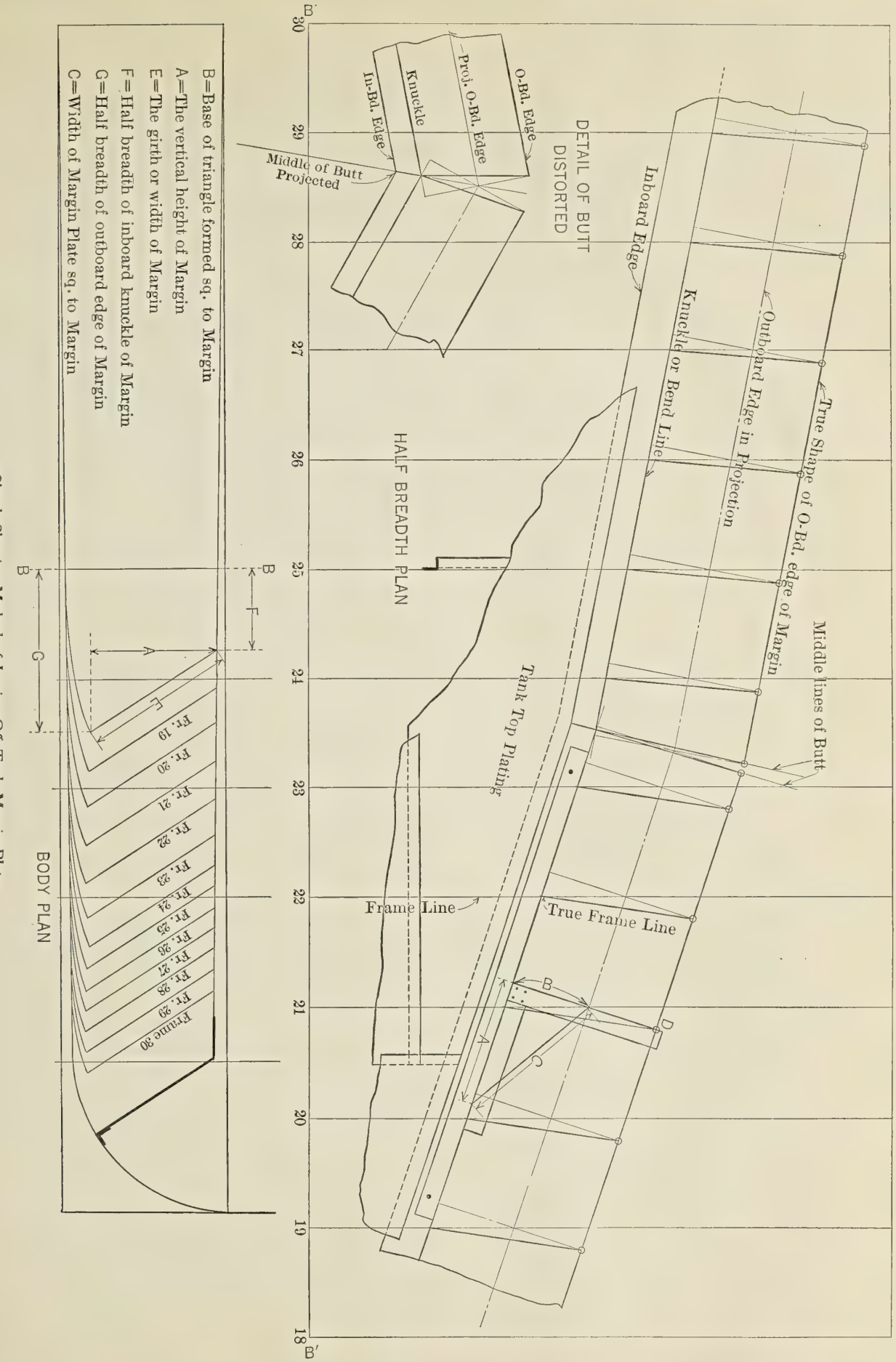
The explanation seems lengthy, but the operation is really short and simple. Other details are better left to the individual himself—once he grasps the main principle.

It is best to take the center of thickness or the neutral axis of the plate in all this kind of operations.

When the tank rises toward the center line of the ship you can easily correct the slight difference this makes in a few of the frame lines and butts. It is best to think those points out for yourself to avoid confusing explanations.

The method described would be unsuitable for some vessels, but on these particular steamers it seems to be a

* General foreman, McDougall-Duluth Company, Duluth, Minn.



Sketch Showing Method of Laying Off Tank Margin Plates

ready and quick job. It accurately accounts for the irregular length of elbow at butt spaces and is right on the spot for attaching to tank top plating, through being developed on the same plan as its arrangement is shown.

Lloyd's Technical Committee Thoroughly Investigating Application of Electric Welding to Shipbuilding

A SPECIAL meeting of the technical committee of Lloyd's Register of Shipping was held recently in London to consider the subject of the application of electric welding to shipbuilding to the extent of eliminating by this method the use of rivets for important structural connections.

Electric welding has, of course, been employed for many years for ship repair work, but its use has been practically confined to parts of the structure not likely to be exposed to important stresses. It is, in fact, only since the early days of the war that such appreciable developments have been made as to appear to afford justification for the great extension now contemplated.

In view of the importance of the subject to the shipbuilding industry of the world, the committee of Lloyd's Register of Shipping have recently carried out a series of carefully devised experiments to determine, as far as can be done by means of tests and analyses, the general trustworthiness of structural connections effected by electric welding and their capacity to stand the strains to which they would be subjected in practice.

The technical committee had before them a report from the Society's chief ship surveyor, setting forth in detail the results of these experiments and dealing very fully with the whole subject.

Demonstration Given

In order to assist the technical committee in their deliberations and to afford others interested an opportunity of witnessing the system in operation, a demonstration was given at the Society's offices in Fenchurch street. Among those present were:

Sir Thomas L. Devitt, Bart., chairman; Sir Edward E. Cooper, deputy chairman, and Sir Thomas J. Storey, K.B.E., chairman of classification committee of Lloyd's Register of Shipping; the Right Hon. Sir Joseph Maclay, Bart., shipping controller; R. B. Stevens, vice-chairman, and J. R. Gordon, one of the members of the American shipping mission; Sir Alfred Yarrow, Bart.; Sir William Beardmore, Bart.; Sir Frederick W. Lewis, Bart.; Sir Thomas Royden, Bart.; Sir Owen Philipps, G.C.M.G., M.P.; Sir Kenneth S. Anderson, K.C.M.G.; Sir Thomas Bell, K.B.E., deputy controller for dockyards and repairs; Sir E. H. Tennyson d'Eyncourt, K.C.B., director of naval construction; Engineer Vice-Admiral Sir G. G. Goodwin, K.C.B., engineer-in-chief of the fleet; Sir George B. Hunter, K.B.E., D.Sc.; Sir George Carter, K.B.E.; Sir Alexander Gracie, K.B.E., M.V.O.; Sir Frederick N. Henderson, K.B.E.; Lieutenant-Colonel Sir Robert S. Horne, K.B.E., Civil Lord of the Admiralty; Sir John Esplen, K.B.E.; Rear-Admiral L. E. Power, C.B., C.V.O., director of dockyards and repairs; Graeme Thompson, C.B., director of transports and shipping; Charles I. de Rougemont, chairman of Lloyd's; J. Herbert Scrutton, vice-president of the Chamber of Shipping of the United Kingdom; Capt. H. B. Hooper, chairman of the London General Shipowners' Society, and Edward F. Nicholls, chairman of the Institute of London Underwriters, as well as representatives of the American, French, Italian and Japanese governments.

Speaking at the informal luncheon which took place after the meeting of the committee, Sir Thomas L. Devitt, Bart., said:

"I would like to say in a few words how very pleased we are to have with us to-day the friends who have honored us with their company to see what we have to show them regarding the proposed application of electric welding to shipbuilding. This subject is one of far-reaching possibilities, and when it came before our committee some months ago they considered that the Society should undertake some practical experiments with a view to testing the reliability of the process.

"These experiments have been carried out under the direction of Mr. Abell, our chief ship surveyor, and with the kind co-operation of Messrs. Cammell Laird & Company, Ltd.

Recommendations of Committee

"They have been fully considered by our technical committee at their meeting to-day, with the result that it has been decided to recommend to the general committee that, under certain conditions to be adopted as a tentative measure, welding may be approved in vessels intended for classification in Lloyd's Register of Shipping.

"I need not enlarge upon the importance of this decision, which will be fully appreciated by this eminently practical assembly. I will only say that the committee of Lloyd's Register of Shipping are pleased to place at the disposal of the shipping community of this country, and of all the Allied nations, the services of the Society's highly trained staff of surveyors, and of its distinguished technical committee, in the consideration of the many complex problems which we have constantly to face in naval architecture and marine engineering.

"The war has brought with it fresh problems in the realm of naval achitecture; and, speaking with a long experience in shipping, I can say without hesitation that never at any time has the Society of Lloyd's Register of Shipping been more anxious to act as 'the guide, philosopher and friend' of the great shipping interests, and never has it been better equipped to handle all such problems than it is at the present time.

"It affords me particular pleasure to welcome here to-day the honored representatives of our Allies in the great struggle in which we are engaged.

Tribute to Allies

"We have with us to-day Mr. Stevens, the vice-chairman of the American shipping mission, and Mr. Gordon, another member of that mission, who is also a member of the American Committee of Lloyd's Register of Shipping, as representatives of our cousins and allies across the Atlantic, who, in pursuance of high ideals and in full recognition of the claims of humanity and civilization, are displaying such vast energy and vigor in support of the cause of liberty and international justice.

"We are likewise honored with the company of representatives of heroic France, valiant Italy and gallant Japan, and we join with them in praying for victory to our arms.

"May I say how pleased we are to have the company of Sir Joseph Maclay, and of the able members of his staff in the Ministry of Shipping? Sir Joseph Maclay has brought to the discharge of his most arduous office abilities of a high order, wide practical experience and shrewd common sense, and he has done much by his capable handling of shipping to make it possible, like Joseph of old, to feed the people; for, in reality, Sir Joseph Maclay, as shipping controller, has also been the food controller, as without a proper use of our ships there would have been little food to control."

Adaptability to Shipbuilding of Craftsmen from Outside Trades

Occupational Analysis of Shipyard and Kindred Outside Trades Used to Classify Craftsmen Suitable for Training as Shipyard Workers

THE following, first published in *U. S. Employment Service Bulletin,* is based upon an occupational analysis of shipyard trades and kindred outside trades made by the Federal Board for Vocational Education. It is published here for the information of those interested in the task of recruiting and training workers for shipbuilding.

For purposes of comparison with outside trades, the shipbuilding trades are divided into three classes:

Class 1.—Shipbuilding trades in which there is no corresponding outside trade, but for which experience in certain trades is an asset.

Class 2.—Shipbuilding trades in which there is a corresponding outside trade, but for which additional special training is necessary for satisfactory work in shipbuilding.

Class 3.—Shipbuilding trades into which outside craftsmen may come without additional special training.

Class 1

Following are the shipbuilding trades (in italics) in which there is no corresponding outside trade. The outside trades listed with each shipbuilding trade are kindred trades in which experience is an asset:

Mold loftsman.—Structural template maker, structural marker or layer out, sheet metal worker, house carpenter, cabinetmaker, naval draftsman, structural, architectural, or mechanical draftsman, and pattern maker.

Shipwright or ship carpenter.—Master carpenter or contractor, house carpenter, rough carpenter or handy man, bridge carpenter, house mover, dock and wharf builder, piledriver man, lumberjack, lumber-yard and sawmill man, millwright, erecting engineer, liner on structural-steel work, machine erector or road man, structural or bridge erector, and elevator constructor.

Ship fitter.—Structural marker, structural fitter, structural erector, structural template maker, structural yardman, and structural draftsman. (Trades less allied, but experience in which is an asset, are blacksmith, boiler maker, sheet-metal worker, ornamental and architectural ironworker, jobbing machinist or auto-repair man, and house carpenter.)

Anglesmith and plate and shape furnaceman.—Blacksmith, horseshoer, wheelwright, blacksmith's helper, striker, back handler, ornamental and architectural ironworker, and steel-mill man.

Rigger and sailmaker.—Sailor and tent and awning man.

Wood calker.—No outside kindred trade, except the somewhat lighter calking done on launches, pleasure boats, and other small craft.

Class 2

Following are the ship trades in which there is a corresponding outside trade, but for which some special training is necessary. The corresponding trades are listed after each of these ship trades:

Marine plumber, marine pipe fitter, and marine coppersmith (pipe-shop trades).—Any experienced journeyman plumber, pipe fitter, or coppersmith can become competent on ship work in a short time and with very little special training. In recruiting men for ship work, these three trades should be drawn upon, as there are no other kindred trades and the common fund of trade knowledge and skill is very large.

Sheet-metal worker.—Heating and ventilation man, tank man, sheet steel and wire mesh locker man, blowpipe man (who installs blower systems in woodworking plants), and cornice man.

Ship joiner.—Cabinetmaker or joiner, furniture maker, and carpenter with experience on inside finish.

Ship electrician.—Inside wireman with experience on conduit work, telephone switchboard man on intercommunicating systems, telephone installer, trouble shooter, and wire chief, repair man on motors and generators, armature winder, and switchboard installer.

Blacksmith.—Hammerman and heavy forger, machine blacksmith, shipsmith, drop forgers, tool dressers, and helpers and strikers.

Outside machinist.—Erecting man on steam engines, turbines, machine tools, or any form of heavy machinery; erecting specialist on gas engines; millwright, erecting man on steam boilers; automobile and gas engine repair man or assembler; and elevator constructor.

Metal chipper and metal calker.—Structural steel worker on tanks, boiler maker used to calking on boiler seams, stonecutter and quarryman accustomed to use of mallet or air hammer and chisel.

Riveter.—Structural riveter and tank riveter. Chippers and calkers are often trained as riveters, since they can use an air hammer.

Class 3

Shipbuilding trades into which the outside craftsman may come without additional special training are:

Machinist.
Boiler maker.
Diesinker.
Pattern maker.
Yard rigger and craneman
Acetylene welder and burner.
Electric welder.
Molder.
Core maker.
Driller and reamer.
Galvanizer.
Machine operator in steel mill or ship shed.
Painter.

COMPARISON OF SHIPBUILDING AND KINDRED OUTSIDE TRADES

Trades Outside of Shipyards	Shipyard Trades in Which These Craftsmen May Be Used
Architectural iron worker	Anglesmith.
Asbestos workers	Pipe coverers.
Auto repair men	Ship fitter. Outside machinist.
Blacksmiths—	
Railroad blacksmiths	Blacksmith. Hammer men. Tool dressers.
Machine blacksmiths	Shipsmiths.
Hammer men	Anglesmiths.
Tool dressers	Plate and shape furnace men. Ship fitters.
Boiler maker	Boiler maker. Ship fitter. Flange turner.
Bricklayer	Pipe coverer. Cementer.
Bucker-up. (*See* Riveter.)	
Cabinet maker	Joiner. Template maker.
Carpenter	Ship carpenter (Shipwright). Ship joiner (if he has had experience on inside work). Mold loftsman. Ship fitter.

Carvers	Carving (in joiner shop).
Carriagesmiths	Blacksmith.
Wagonsmith	Anglesmith.
Wheelwright	Plate and shape furnace man.
Chipper	Ship fitter.
	Chipper (in foundry).
	Chipper (in yard and on ship).
	Calker (steel).
	Riveter.
Concrete man	Cementer.
	Pipe coverer.
Core maker	Core maker.
Coppersmith	Coppersmith.
Dock builders	Ship carpenters (stage builders).
Drop forger	Drop forger.
Engineers, steam	Outside machinists (if they have had erecting or repair experience).
	Pipe fitters.
Erecting engineer or road man	Outside machinist.
	Shipwright.
Elevator constructor	Outside machinist.
	Shipwright.
Electrical workers—	
Outside man	Outside wireman in yard.
Inside wireman	Wireman on ship.
Telephone installer	Wiring on intercommunicating systems.
Wire chief	
Trouble shooter	
Switchboard man	
Motor repair man	Motor repairer and installer.
Armature winder	Armature winder.
Galvanizer	Galvanizer.
Gas fitter. (*See* Pipe fitter.)	
Granite cutters	Chippers and calkers.
Stone cutters	
Quarrymen	Drillers and reamers.
Heater. (*See* Riveter.)	
Horseshoers	Blacksmith.
	Anglesmith.
	Plate and shape furnace man (or helpers).
	Ship fitter.
House mover	Shipwright.
Lumberjacks	Ship carpenters.
	Lumber handlers and stage builders.
Machinists	Floor hands.
	Bench hands.
	Machine hands.
	Machine operators.
	Outside machinists.
Molders	Molders of all kinds.
	Green sand, dry sand, bench, side floor and floor, cast iron, steel and brass.
Ornamental iron worker	Anglesmith.
Painter	Painter.
Pipe fitters—	
Steam fitter	Pipe fitters.
Gas fitter	
Pile-driver man	Shipwright.
Plumbers	Plumbers.
Painters	Painters (wood and metal).
Passer. (*See* Riveter.)	
Plasterers	Pipe coverers, cementers.
Quarrymen. (*See* Granite cutters.)	
Riggers	Yard riggers.
	Bolter-up.
Riveters—	
Structural	Riveters.
Tank	
Automobile	
Bucker-ups	Holder-ons.
Passers, heaters	Passers, heaters.
Sailors	Rigger (in rigging loft).
Steam fitter. (*See* Pipe fitter.)	
Structural iron workers—	
Structural marker	Ship fitter.
	Loftsman.
Structural fitter	Assembler or bolter-up.
	Ship fitter.
	Loftsman.
Structural liner or regulator	Shipwright.
	Assembler.
	Ship fitter.
Structural erector	Assembler or bolter-up.
	Ship fitter.
	Shipwright.
	Riveter.
Structural template maker	Template maker.
	Loftsman.
Structural draftsmen	Draftsman.
	Mold loftsman.
	Ship fitter.
Structural yard man	Material man.
	Cold sawyer.
	Yard man.
Sheet-metal worker	Sheet-metal worker.
	Ship fitter.
	Mold loftsman.
Tent and awning maker	Sail maker.
Wagonsmith. (*See* Carriagesmith.)	
Wheelwright. (*See* Carriagesmith.)	
Wood finisher	Wood finisher.

NOTE.—Helpers in practically all of these trades can be used.

Boat Lowering Appliances*

BY J. R. HODGE

AT the present time, when our seagoing members are valiantly pursuing their occupations under unusual conditions, they are entitled to every consideration which minimizes their risk. Accordingly, this opportunity is taken to introduce the subject of boat-lowering appliances with a view to bringing out discussion upon the merits of

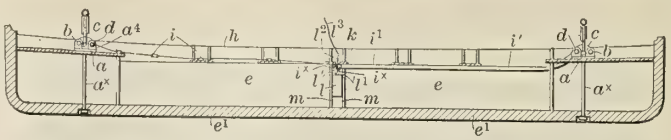


Fig. 1.—Longitudinal Section of a Ship's Boat to Which Disengaging Gear Is Applied

the gear described below, which overcomes the disadvantages associated with the lowering and disengaging of boats in emergencies at sea.

The type of apparatus evolved is for disengaging gear simultaneously and automatically at both ends of the boat,

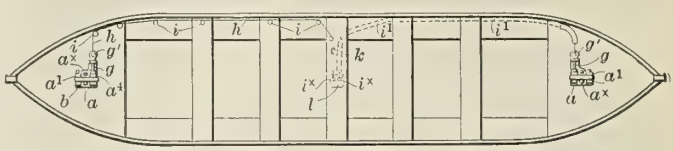


Fig. 2.—Plan Showing Connection of Disengaging Gear With Central Releasing Apparatus

to free it from the davit falls or tackles as soon as the boat is water borne.

The disengaging gear consists of a hinged or pivoted curved link at each end of the boat adapted to be hooked to the falls or other tackle for hoisting and lowering the boats; means for releasing the link; chains or ropes connected to a suitable place in the boat and to a weight. As long as the boat is suspended the links cannot move, con-

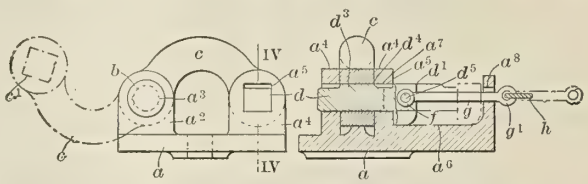


Fig. 3.—Front Elevation of the Disengaging Gear

sequently the weight cannot fall or move by gravity. As soon as the boat becomes water borne and the tension or pull on the curved links ceases, the weight is free to move or fall. In so doing it releases both links and the boat is disengaged from the falls or tackles. The boat is provided at each end with a metal plate base or bracket furnished with means for attachment to the boat at or near each end. Hinged or pivoted to each base plate is a link adapted to engage with the davit falls or hoisting and lowering tackle; a bolt or catch is also mounted on the base plate to engage with the free end of the link. Bolts in the base plate are each connected by a suitably guided chain or wire rope to a weight, which is thereby suspended in the middle or other convenient part of the boat.

The base plate a, bolted to the keel e^1 by a screw or bolt a^x, is made somewhat in the shape of an L, Fig. 1. One member, a^1, (Fig. 2) is provided at each end with two perforated lugs; one pair of these lugs, as shown in

* From a paper presented before the Institute of Marine Engineers, London, April 16, 1918.

Fig. 3, is furnished with round holes in line with each other to receive a pin *b*, on which is mounted one end of a similarly perforated and bent link *c*; the lugs at the other end are provided with approximately square perforations, and the other end of the link *c* is similarly perforated to receive a square bolt *d*. This bolt has a square head flattened on one side so as to rest and slide on the top of the other member of the base plate, which not only serves as a guide but is also adapted to limit the movement of the bolt. As an additional safeguard, the central portion of the bolt may be a little thicker in the middle than at the ends, so as to form a projection d^3, the edge of which facing the head d^1 may be chamfered at d^4. The square hole in the bearing for the bolt is also correspondingly chamfered at a^7, the object being to form a kind of lock or safety device to prevent the bolt from being prematurely or accidentally withdrawn until the boat is entirely water borne. As soon as this occurs the bolt drops onto the bottoms of the holes. The projection d^6 is then below the level of the chamfered edge a^7 of the square hole in the bearings. The end of the bolt has a transverse hole d^5 to receive a pin for connecting thereto the fork of a forked rod *g*, which passes through a hole in a lug, a^8, also adapted to limit the movement of the bolt. The other end of the forked rod is connected to a chain or wire rope *h*, which is suitably guided around guide pulleys or fairleads *i*, as shown on the left-hand sides of Figs. 1 and 2, or through pipes or tubes i^4, such as shown on the right-hand side of these figures, until it reaches the middle thwart, where it is passed over another pulley, i^x, one for each chain or wire, and connected to a weight, *l*, having two eyes or holes, one for each rope or chain. This weight is conveniently guided between two uprights screwed to the thwart to prevent the weight from swinging about in a seaway. If desired, the weight has a rod, l^2, passing through a hole in the thwart and provided at the top with an eye for a lanyard, l^3, to permit of pulling up the weight when hooking on the falls.

Oil Fuel for Steamships

B. C. Pearson, chairman of the Eagle Oil Transport Company, Ltd., of Great Britain, recently reported to his stockholders about the utilization of oil on its ships as follows:

The question of motive power of the new vessels had been very carefully considered by the board and the company's technical staff in conjunction with the various builders, with the resulting decision that turbines and oil-fired boilers were being installed. There could, he thought, be no doubt that at no distant date internal combustion engines of the desired type would be established practice for marine purposes. Internal combustion engines, however, had not yet proved of equal reliability to steam, and in any event the large size of their new vessels and the horsepower correspondingly required precluded the use of the Diesel engine in the present case.

Two years ago the then chairman gave the approximate comparison of a ton of liquid fuel used in Diesel engines as performing four times the work of an equal weight of coal used for steam-raising. Although their new vessels would not reach this position of relative economy in fuel consumption, the directors believed that in installing the most efficient steam motive power—namely, the latest type of high speed turbines, geared down to the most efficient propeller speed, and by repeating their existing practice of oil-firing their boilers—they were making an appreciable step forward in marine engineering practice as applied to large cargo vessels, and should, in fact, be reaching an eminently satisfactory half-way house.

Internal-Combustion Engine Lubrication and Lubricants*

BY P. H. CONRADSON

THE main consideration in the selection of oil for the various classes of service are not well understood. Too much weight is given to vague inferences as to the relative value of viscosity and flash point alone, without taking into consideration many other important factors; and while it is true that some few engine manufacturers have conducted exhaustive investigations to determine just what particular grade of oil should be used by their engines, the greater part of the work of developing suitable lubricants for the various combustion engines has been done by the refiners and dealers of oil.

While the determination of viscosity—that is, body or consistency at a given temperature—is one of the vital tests usually applied to lubricating oil for internal-combustion engines, it is of importance only when the user of the oil is thoroughly familiar with the characteristics of the different crude oils of which it is made and is sure that the mechanical condition calls for the use of an oil having the stated viscosity. Two oils of the same viscosity, made from different crudes, may behave quite differently under identical working conditions.

Viscosity Tests and Temperature

The determination of viscosity of an oil, to be of the greatest value, should be made not only at the lower temperatures, but also as near the temperature of its use as consistent. On the one hand, an oil of low viscosity might be preferable, since it absorbs less power than a thicker oil in the separation of metallic surfaces moving at a high velocity over each other; in other words, high viscosity means a high internal friction. On the other hand, if the oil is too thin it is more easily displaced from between the bearing surfaces, and a heavier oil might then be preferable, as the engine will be more flexible at low speed, owing to better seal and less leakage. Therefore, due consideration must be given to the influence of temperature on the viscosity, and to the necessity of selecting the proper grade for the service required.

Owing to the comparatively high temperature under service conditions, there generally is no trouble from the oil being too thick when once in use. However, an oil must possess a degree of fluidity at ordinary temperatures —which are influenced by climatic conditions—suited to the method of supplying the oil to the working parts, so as to obtain proper lubrication at the start. A lubricating system with exposed pipes, especially a force-feed system, should have a lower "cold-test" oil to meet these conditions; while in a system where the oil is carried in a pump integral with the engine crank case and where the supply pipes are not exposed, all parts of the system quickly become sufficiently heated to promote a positive circulation and an oil with a higher "cold test" may be used with good results.

The flash point of an oil is of no particular value after the oil has once entered the explosion chamber, where the temperature is considerably higher than that of the

* From a paper before the American Society for Testing Materials, Atlantic City, June, 1918.

flash point. Nevertheless, it is important to use an oil of sufficiently high flash point for reasons of economy if for no other, to resist the vaporization which takes place when the oil comes in contact with the highly heated surface of the piston head, and other parts below the piston. In considering this it is well to remember that with many oils there is little connection between the evaporation (heat) loss and the flash point. Investigation has shown that while two oils may have the same flash points, the percentages of evaporation loss at a given temperature may be quite different. Generally speaking, however, the evaporation loss is greater in oils having a low flash point.

Obviously, that oil which, when subjected to an evaporation test at a certain temperature, loses the least and leaves a residue that has been broken up or altered in character as little as possible by the heat treatment is the most desirable for lubrication of internal-combustion engines. Therefore, the evaporation and oxidation tests offer a promising means of examining the oil and noting the changes that develop in different oils under similar conditions of treatment.

Oil consists principally or entirely of compounds of carbon and hydrogen. At high temperatures these hydrocarbons decompose, forming volatile combustible gases and heavy hydrocarbons, or carbonaceous matter, and free carbon. This breaking up may be due to improper methods of refining or to the nature of the crude oil. Only the most highly refined and filtered oils should be recommended to meet these conditions.

Much has been written about the carbon residue of the oils for this class of service. The carbon in all oils can be fixed by driving off the oil vapors (without addition of air), leaving a layer of carbon deposit, called carbon residue. The condition of the carbon formation in the cylinder is somewhat different from that found in the carbon-residue test, due to the fact that in the cylinder the oil is spread out in a thin film on hot metal surfaces, and exposed to the burning gases of the explosion, which may carry widely varying amounts of oxygen to combine with the oil. Also, the amount of carbon deposited in the cylinders is governed by the amount of oil reaching the explosion chamber, and may depend to a great extent upon the mechanical fit of the pistons, piston rings and cylinders. It is expected that some oil will find its way into the combustion space, but it is assumed that it will be burned up without depositing an excessive amount of carbon on the cylinder walls and pistons.

One of the most injurious effects of improper lubrication is the formation of this carbon deposit around and under the piston rings. Such a deposit soon renders the spring rings inoperative; they become partly fastened in their grooves, and in this condition form one of the most prolific causes of cut and scored cylinders and broken piston rings. One of the causes of this trouble may be the use of too much oil. From the result of much investigation along this line it has been conclusively demonstrated that an oil with the lowest carbon residue, other things being equal, will leave behind the lowest carbon deposit in the explosion chamber.

In connection with the physical characteristics of the carbon deposit it is of importance to select a lubricant which leaves a loose and flaky or soft carbon deposit, easily removed, rather than one leaving a dense, hard deposit difficult to remove.

Assembling and Regulating Ship's Structure

Rigid Supervision and Strict Check and Recheck System Necessary to Eliminate Errors in Assembling Fabricated Ships

BY T. L. COHEE*

IN view of the gigantic programme of turning out ships for the government, so expeditiously as to combat the submarine menace and to provide a merchant marine in keeping with the needs of the United States, it may be worth while to contribute a few practical notes on the assembling and regulating of ship's structure, since the time for actual building is present and the "on paper" period of the game is past. It is well to have spirit and enthusiasm, but the programme should not be treated as a task similar to the manufacturing of a certain number of drop forgings, or to the molding out of so many slabs of concrete, or the digging of so many cubic yards of earth. Nor is it exactly similar to the erection of large structural bridges or buildings.

The riveting problem, the most continuously repeated operation in the construction of ships, is not merely a plain example in arithmetic in which so many rivets are to be driven in a ship. Along that line of reasoning, one gang would be capable of driving so many rivets in a day, and when multiplied by one hundred rivet gangs, so many more could be driven in one day. Among the mass of multitudinous details involved, however, the preparation of the hole to receive the rivet must be noted. This work requires a great many other skilled men.

In the assembling and regulating of a large ship of thousands of units, even though hundreds of said units may be apparently alike, that factor—the human element of error—steps in and must be considered. When it is a fact that the possibility of error begins in the drawing room, thence progresses into the loft, in the template in all the various processes of fabrication, the structure becomes one great flexible mass that must be regulated, checked and rechecked.

The writer's experience dates back to the period of the "lifting" or templating of one structural member, erection, and then the repetition of the process throughout to completion. I have seen the gradual improvement of the methods employed in shipbuilding, up to the laying off and erection of 90 percent of the whole ship from mold loft template. I have seen the latter condition duplicated, that is, several ships built from one set of templates. Choosing a set of three vessels as an example, in number one the results in the assembly and regulating may be all that could be desired; in the case of number two, an ever-increasing shrinkage occurs in one place or a shortening of members at other places; while in number three the

* Foreman shipfitter (new construction), Hull Division, League Island Navy Yard, Philadelphia, Pa.

riveting of members follows the assembly so closely that gain or stretch becomes pronounced. As a result, the interlocking members are consigned to scrap and conditions rectified to suit with new materials. These conditions show that if a vessel were put together, all parts properly fitted piece by piece, and then disassembled for the purpose of using the parts as standard templates for the duplication of a number of vessels to be constructed later, the possibility of human error would bring about conditions similar to those noted above. Therefore, to minimize the possibility of error in the assembly of the fabricated ship, where hundreds of units are fabricated at different shops and later in assembly must member with one another, the strictest sort of check, recheck and inspection is necessary. This rigid and effective supervision must also follow into the period of assembly at the yard.

Process of Assembling and Regulating Ship's Structure

In assembling and regulating a ship's structure, expansion and contraction must be eradicated. Then, if we are informed that 25 percent of the riveting will be done in the ship fabrication, a great deal of that chance for "come and go" will have been taken up, leaving little chance at the yard for rectifying these faults.

The writer has found that when assembling a constant check must be maintained on structure, and the work regulated to proper position in advance of the erection of the next member. In other words, when regulating a member, one is at the same time preparing to unite it with the structure to follow.

It is customary for the riggers (at some yards called "erectors") and the regulator, who is a shipfitter, to coordinate. The rigger hoists the work, places it in position and secures it with just enough bolts to hold it in place. Here his function ends. The shipfitter then regulates it to its true position—or possibly its approximate position, depending on the installation of the next member—after securing it with possibly a half dozen bolts. A gang of bolters follow and place enough bolts in the work to bring the members into intimate contact, ready for the reaming and recountersinking of holes, the reaming and bolting gangs, of course, working in conjunction.

When the work is reamed the bolters clean out the foreign matter that may have collected between the faying surfaces, and, at the direction of the foreman calker, insert stopwaters where necessary. I may add that when the point is reached where insertion of stopwaters takes place, skilled bolters readily know where and how to apply these; but when only semi-skilled workman are employed, this function is best directed by the foreman calker, who is eventually held responsible for getting the structure water or oil tight, as the case may be. When the structure is securely bolted and the former bolt holes reamed and recountersunk, the work is then ready for riveting.

Regulating Decks

In regulating a deck, assuming that the beams are in position, the first strake of plating on the center line is regulated in position and checked to length. This operation ties the beams and regulates the side of the ship to its proper transverse position. Very often better results may be obtained by regulating the side of ship with the stringer plate, since this is heavier and can stand the heavy drifting required in adjusting the beams to their "in" or "out" position. The center line strake of plating should be in position as soon as possible, in order to place the stanchions in position ready to bear the beams of the deck above. If the stanchions are not ready, temporary shores should be used. The other strakes of plating can then be placed in position, one strake at a time. Each should be temporarily regulated pending the installation of all the strakes. After all are installed, it is better practice to begin regulating amidship, usually at a bulkhead that has been "horned," that is, adjusted perpendicular to the fore and aft center line of ship, work forward and aft, as well as athwartship, checking at the next bulkhead reached.

In regulating a deck, one side often runs ahead or astern of the side opposite; one strake of plating will show a tendency to run away from the adjoining strake. To overcome this defect some of the yards have adopted the rule of omitting one strake of plating port and starboard and templating them from ship. However, if it is possible, lay off the whole deck structure from mold loft template, provided the loft has sufficient floor space to lay down the whole deck at once. Since laying the deck down in several sections intensifies the chances of irregular work, from the standpoint of centralizing the work in one department, it is better to lay off the complete deck. Templating from ship causes a hitch or delay just when continuity of erection is expected. Possibly a bulkhead is to be installed on the deck, or there may be the beginning of a fore and aft bulkhead on this omitted strake. In these cases the shipfitter and loft would not be working together.

Assembling the Keel

It is very important that extraordinary care should be taken in the assembling of the outer keel, the inner keel (if any) and the vertical keel. Time spent in careful checking of this structure means time saved in assembling the members to follow. If the keel blocks are ready for installation of the keel it is better practice to assemble the keel on the blocks, rather than to assemble it in the shop in sections, since, at most, only 50 percent of the work can be shop riveted on account of the overlapping or break in angle butts. The trouble encountered in assembling on the blocks at the junctions of the sections more than offsets the gain in shop riveting.

Assembling Bottom Shells, Side Shells and Bulkheads

I have seen eighteen or twenty plates at a stretch placed in position on the garboard (lap butted and lap edged with one-inch rivet holes). These matched up nicely with the keel lap, and the holes at each butt lapped fairly well. Apparently this would be considered well regulated and would be pronounced good work. Then when the "B" strake of plating is put in position it is seen that the "A" or garboard strake has gained probably an inch in length. Readjustment of the garboard strake follows. The difference in the holes is not then apparent to the eye.

It is customary at some yards to nick the position of the sheet edges on the heels of the frames from the mold loft template as an aid in regulating the plates. The plate edges are not, however, at all times sheared accurately enough for this to be a dependable guide. Besides, the loftsmen are accustomed to place the sight edges of the plating on template, whereas, when regulating shell plates, the edge of the plate next to the frame is the one that is needed.

A common fault encountered in regulating the side shell is the tendency of the plating to lose in height, due to the weight of plating on the bolts and the size of the holes, which are a sixteenth of an inch larger than the bolts.

The conditions noted in the assembly of bottom shell

are also common in the assembly of large bulkheads when assembled on the ground. They should be checked both for height and breadth. It is best to assemble a bulkhead on the ground, even though it may have to be separated and hoisted into position on ship in sections which suit capacity of crane.

Water Lines on Bulkheads

As a check in assembly, it is good practice to have at least one water line stamped on the plate from the template when the plates are in horizontal strakes. When in vertical strakes, at least two lines should be stamped on the plate, one at the top and one at the bottom. Corresponding water lines should be stamped on the heels of the stiffeners.

These water lines are not only convenient in getting accurate assembly but are very beneficial for later work, such as the centering of shaft heights for pumps, motors and various auxiliary foundations that may be subsequently erected by heights given from base, which is generally not accessible.

It is, of course, a level line and is frequently needed in the construction of the ship even after she is in the water. The water lines are center punched on the plate from the template in even feet and are then enclosed by a paint mark, so that they can be plainly seen. A water line on the floors is very essential to accurate assembly, as well as being of great benefit to the ship carpenter in keeping the ship fair, especially with a curving inner bottom.

At some yards a datum line is established conveniently below the keel by the use of a transit, and spots from the body plan are given to the sight edges of shell plates at frequent intervals. By these means the ship carpenter keeps the ship fair. This datum line is marked on ordinary uprights fastened to the ground sleeper at certain intervals. When a spot is desired at any point between uprights, a line is stretched from one upright to another. This method of keeping the ship fair is probably satisfactory when the foundation is of concrete, but when it is constructed of ordinary piling the datum line has to be frequently checked as the ship takes on weight and settles.

Angle Connections

In attempting to make templates symmetrically for longitudinal connections to floor, and similar operations, the human element of error again intrudes. In consequence, one flange of the angle will vary slightly from the other, just enough to cause trouble in the assembly. To overcome this fault, it is better to make the difference in flanges pronounced and easily seen, so that the angle will have only one definite relation to the connecting part. Another fault arises when making the clip symmetrical—holes spaced alike in both flanges. The riveting becomes more difficult when the holes are opposite and the sectional area of the shape is in consequence considerably reduced.

This carries the reader to mold loft methods, a subject which may be touched on later.

Control of Hull Construction of 5,000-Ton Deadweight Fabricated Steel Vessel

System Employed at Yard Where Straight Work was Produced at Outside Shops and Furnaced Work Turned Out at Yard

BY FABRICATOR

PROPER control of plans, material orders, material deliveries and the fabricating shop is necessary to obtain the advantages offered by the design of the standard fabricated steel ship. In addition, this control develops a high type of organization, both in the yard and in the office, and eliminates friction between the two, as well as establishing full confidence outside.

As preliminary control is arbitrary, it is necessarily simple and direct, and its effectiveness depends upon the executive ability behind it. It may be considered the office policy of the shipyard in that it makes provision only for the completion of the plans prior to their need, ordering of material in time to insure satisfactory delivery of raw material to the yard and fabricator, delivery of fabricated items and machinery and equipment.

The yard is "controlled" by the fact that it will work on what it receives, though it is kept fully posted on material ordered and moving. As this method has been proved satisfactory in a yard where all of the straight work was produced by a distant fabricator, including oiltight and watertight work, and the bent and furnaced work turned out at the yard, it will be given in detail, using approximate values—relatively correct.

Nine 5,000-ton deadweight Ferris type steel cargo vessels were to be built; three ways were available, and 90-day periods were fixed, arbitrarily, for completion of each lot of three vessels, so as to complete the nine vessels 270 days after laying the keel. Keels were laid on each way at the same time to start rivalry between the ways.

From previous records it was assumed that approximately 1,911 tons of steel bars, plates and shapes would be required for each vessel. The hull structure was classified to meet contract payments, and the tonnage spread as follows:

Item	Includes	Weight, Percent
Keel	Flat plate keel and center vertical keelson, both complete.	2.6
Shell plating (bottom)	Garboard to bilge strakes, inclusive and complete.	9.2
Floors	All floors, shell and tank top liners and side keelsons, complete.	12.8
Tank top	All tank top plating, machinery foundations, shaft alley flat and foundations, cover plates and miscellaneous flats, complete.	12.1
Bulkheads	All bulkheads, tank top to second and upper decks, deep tank and peaks' swash-bulkheads, complete.	6.5

FORM ES—ERECTION SCHEDULE
FOR NINE 5,000-TON DEADWEIGHT STEEL CARGO VESSELS.

January 10, 1918.

		Estimated Weight, Tons.	Days to Erect.	Completion Dates.		
				Hulls, 87, 88, 89	Hulls, 90, 91, 92.	Hulls, 93, 94, 95.
Keel blocks laid	K	.....	1.0	4/9	6/10	8/12
Keel	1	47.30	1.3	4/10	6/11	8/13
Bottom shell (A-E)	2	176.00	4.9	4/15	6/16	8/18
Stem	3	.....	....	4/15	6/16	8/18
Stern frame	4	....	....	4/15	6/16	8/18
Floors	5	244.70	6.8	4/22	6/25	8/25
Tank top	6	230.10	6.4	4/28	7/1	9/11
Bulkheads	7	123.10	3.3	5/2	7/4	9/5
Frames	8	242.00	6.7	5/9	7/11	9/12
Deck beams	9	118.60	3.3	5/12	7/14	9/15
Shell plating	10	307.50	8.5	5/22	7/23	9/24
Decks	11	195.90	5.5	5/26	7/28	9/30
Houses	12	226.30	6.3	6/1	8/3	10/6
Preparation	P	.....	7.0	6/8	8/10	10/13
Launch	L	.....	1.0	6/9	8/11	10/14
Totals	.....	1,911.50	62.0			

Lay keels of hulls 87, 88, 89 on April 9. Launch hulls 87, 88, 89 on June 9. (Allow seven days for preparation.) 53 working days from April 9. 1,911 tons to erect each ship for period 36 tons a day each ship for period.
Fabricator must ship six days prior to our requirements.

FORM SRS—STEEL REQUISITION SCHEDULE
FOR NINE 5,000-TON DEADWEIGHT STEEL CARGO VESSELS.

January 10, 1918.

Item.	Seq.	Req. Due.	P. O. Placed.	Tons of Steel Ordered.		
				Plates.	Shapes.	Total.
Keel	1	Rush	1/15	39.8	7.5	47.3
Bottom shell	2	"	1/15	176.0	....	176.0
Floors	3	"	1/15	143.2	101.5	244.7
Tank top	4	"	1/14	179.3	50.8	230.1
Bulkhead	5	1/10	1/12	62.9	60.2	123.1
Frames	6	1/10	1/12	64.5	177.5	242.0
Deck beams	7	1/15	1/17	9.5	109.1	118.6
Shell plating	8	1/20	1/23	307.5	....	307.5
Decks	9	1/23	1/30	195.9	11.0	184.9
Houses	10	1/30	2/5	168.5	57.8	226.3
Stem	11	....	2/15	.....	.....	5.5
Stern frame	12	....	2/15	.....	.....	9.7
Rivets	13	....	1/12	.....	.....	200.0
....	....	....	2/10	.....	.....	60.0

Purchase Orders to cover nine vessels placed simultaneously with deliveries specified as shown on Schedules YS and FS.

FORM FS—FABRICATOR'S ERECTION SCHEDULE
FOR NINE 5,000-TON DEADWEIGHT STEEL CARGO VESSELS.

		Estimated Weight 1 Hull.	Estimat'd Weight 1 Lot.	Days to Fabricator.	Lot 1.			Lot 2.			Lot 3.		
					Must Ship.	Due at Fabricator.	Mill Ships.	Must Ship.	Due at Fabricator.	Mill Ships.	Must Ship.	Due at Fabricator.	Mill Ships.
Keel	1	42.1	126.3	1.8	4/2	3/25	2/25	6/3	5/30	4/30	8/5	7/31	6/30
Bottom shell	2	87.3	261.9	3.3	4/5	4/1	3/1	6/6	6/1	5/1	8/8	8/2	7/2
Floors	3	215.2	645.6	8.2	4/14	4/5	3/5	6/14	6/9	5/9	8/17	8/10	7/10
Tank top	4	165.7	497.1	6.2	4/20	4/14	3/14	6/21	6/15	5/15	8/23	8/16	7/16
Bulkheads	5	105.6	316.8	3.9	4/24	4/20	3/20	6/25	6/19	5/19	8/27	8/20	7/20
Frames	6	102.4	307.2	3.8	4/28	4/24	3/24	6/29	6/23	5/23	8/31	8/24	7/24
Deck beams	7	107.6	322.8	4.0	5/2	4/28	3/28	7/3	6/27	5/27	9/4	8/28	7/28
Shell plating	8	127.7	383.1	4.8	5/7	5/2	4/2	7/8	7/1	6/1	9/9	8/31	7/31
Decks	9	170.7	512.1	6.4	5/15	5/7	4/7	7/14	7/7	6/7	9/15	9/6	8/6
Houses	10	208.3	624.9	7.8	5/21	5/13	4/13	7/22	7/15	6/15	9/21	9/14	8/14
Totals	.....	1332.6	3997.8	50.0									

Data—1333 tons to fabricate for each hull. Material put through in three lots of three hulls each (3999 tons). 50 days allowed for each lot. 80 tons to fabricate daily. Mills to ship 30 days prior to requirements. Lot 1 covers hulls 87, 88, 89. Lot 2 covers hulls 90, 91, 92. Lot 3 covers hulls 93, 94, 95.

FORM YS—YARD SHOP SCHEDULE
FOR NINE 5,000-TON DEADWEIGHT STEEL CARGO VESSELS.

January 10, 1918.

		Estimated Weight 1 Hull.	Estimated Weight 1 Lot.	Days to Fabricator.	Lot 1.		Lot 2.		Lot 3.	
					Must Comp.	Mill Ships.	Must Complete.	Mill Ships.	Must Complete.	Mill Ships.
Keel	1	5.2	15.6	.5	4/7	3/7	6/8	5/8	8/9	7/9
Bottom shell	2	88.7	266.1	7.7	4/15	3/15	6/16	5/16	8/17	7/17
Floors	3	29.5	88.5	2.6	4/18	3/18	6/19	5/19	8/20	7/20
Tank top	4	64.4	193.2	5.5	4/23	3/23	6/24	5/24	8/25	7/25
Bulkheads	5	17.5	52.5	1.6	4/25	3/25	6/26	5/26	8/27	7/27
Frames	6	139.6	418.8	11.9	5/6	4/6	7/7	6/7	9/8	8/8
Deck beams	7	11.0	33.0	1.0	5/7	4/7	7/8	6/8	9/9	8/9
Shell plating	8	179.8	539.4	15.4	5/22	4/22	7/23	6/23	9/24	8/24
Decks	9	25.2	75.6	2.2	5/24	4/24	7/25	6/25	9/26	8/26
Houses	10	18.0	54.0	1.6	5/26	4/26	7/27	6/27	9/28	8/28
Totals	.....	578.9	1736.7	50.0	....	....	....	....	....	....

Data—579 tons to fabricate for each hull. Material put through in three lots of three hulls each (1737 tons). 50 days allowed for each lot. 35 tons to fabricate daily. Mills to ship 30 days prior to requirements. Lot 1 covers hulls 87, 88, 89. Lot 2 covers hulls 90, 91, 92. Lot 3 covers hulls 93, 94, 95. Shop must complete two days prior to erection gang requirements.

Frames	All frames attached to tank top and to floors in peaks and second deck, all pillars and stringers below upper and second decks, complete.	12.6
Deck beams	All second deck and upper deck beams and girders and gussets, complete.	6.2
Shell plating	Above bilge to and including sheer strake.	16.0
Decks	All second and upper deck plating, all deck foundations, hatch fittings.	10.3
Houses	All frames, stanchions, bulkheads, beams, deck and shell plating above upper deck; all casings and escape tunnel, complete.	11.7

The first three vessels were to be launched 60 days after the keels were laid and 7 days were allowed for preparation and final inspection previous to launching, leaving 53 days for the erection of 1,911 tons of steel.

An Erection Schedule (Form ES) was developed and used as a basis for the Fabricator's Schedule (Form FS) and Yard Schedule (Form YS), Steel Requisition Schedule (SRS) and Drawing Room Schedule (Form DRS).

The tonnage handled by the fabricator for each vessel was approximately 1,332 tons, spread as follows:

Item	Weight, Percent	Weight, Tons
Keel	3.1	42.1
Bottom plating (strake A to E)	6.5	87.3
Floors	16.2	215.2
Tank top	12.3	165.7
Bulkheads	8.0	105.6
Frames	7.8	102.4
Deck beams and girders	8.0	107.6
Shell plating	9.6	127.7
Decks	13.0	170.7
Houses	15.5	208.3
Total	100.0	1332.6

From this the Fabricator's Schedule (Form FS) was developed.

All car movements were carefully followed, but 30 days were allowed for the railroad to deliver the steel to the fabricator and yard from the steel mill, and 6 days to deliver the fabricated items to the yard from the fabricator. This is quite necessary to cover delays due to bad order cars and bunching of cars at destination, which, though very undesirable, cannot be advantageously avoided.

The Yard Schedule (Form YS) was devised to cover the output of the yard shop, and with the Yard Erection Schedule and Fabricator's Schedule covered our steel control.

A classification of the hull to differentiate the work done by the fabricator from that done by the yard was made, dividing the vessel into five transverse sections:

Section 1.—Covered all items from the stem aft to the collision bulkhead.

Section 2.—Covered all items from the collision bulkhead to the frame at 42.

Section 3.—Covered all items in th eparallel middle body from frame at 42 to frame at 93.

Section 4.—Covered all items from frame at 93 to bulkhead at 128.

Section 5.—Covered all items aft of frame at 128.

Practically all items of Sections 1 and 5 were fabricated at the yard; the furnaced items of Sections 2 and 4 were fabricated at the yard, and the balance of the items at the fabricators; all of Section 3 was done at the fabricators.

This gave us a definite basis for our Steel Requisition and Drawing Room Schedules.

It was intended to have requisitions for steel issued about 10 weeks before the mill delivery specified. This would allow four weeks for the allocation and the balance for the mill to schedule and produce.

Requisitions for the inner bottom material for the first three boats had to be rushed to the mills, but no confusion or delay was caused, as it was known definitely just what was wanted and when it was wanted.

Material schedules covering the items required for one ship were typed on lightweight, transparent paper—carbon backed to be blue-printed. Separate requisitions and purchase orders were made for each hull and the necessary material schedules blue-printed. The requisition and purchase orders bore all of the delivery dates and necessary information for the hull which it covered. Separating the hulls in this way gave very close and accurate control.

This method carried one shipyard over the high spots very satisfactorily and should at least be suggestive.

(*To be continued.*)

Steam Preferred

A man had the running of a heavy oil engine in a boat plying between two points. He also had a steam license and applied for a position on a steamboat. When asked why he wished to leave the job of handling the oil motor, he said: "Oh, the engine ran all right and we made our trips, but I got tired of feeling as if I was a tight-rope walker."

"What do you mean?"

"Well, you see, a tight-rope walker is pretty sure to walk his wire without falling off, but he is mighty glad when he gets across, and that is just the way I felt in making my trips—I was pretty sure to get there, but was just tickled to death when I did."

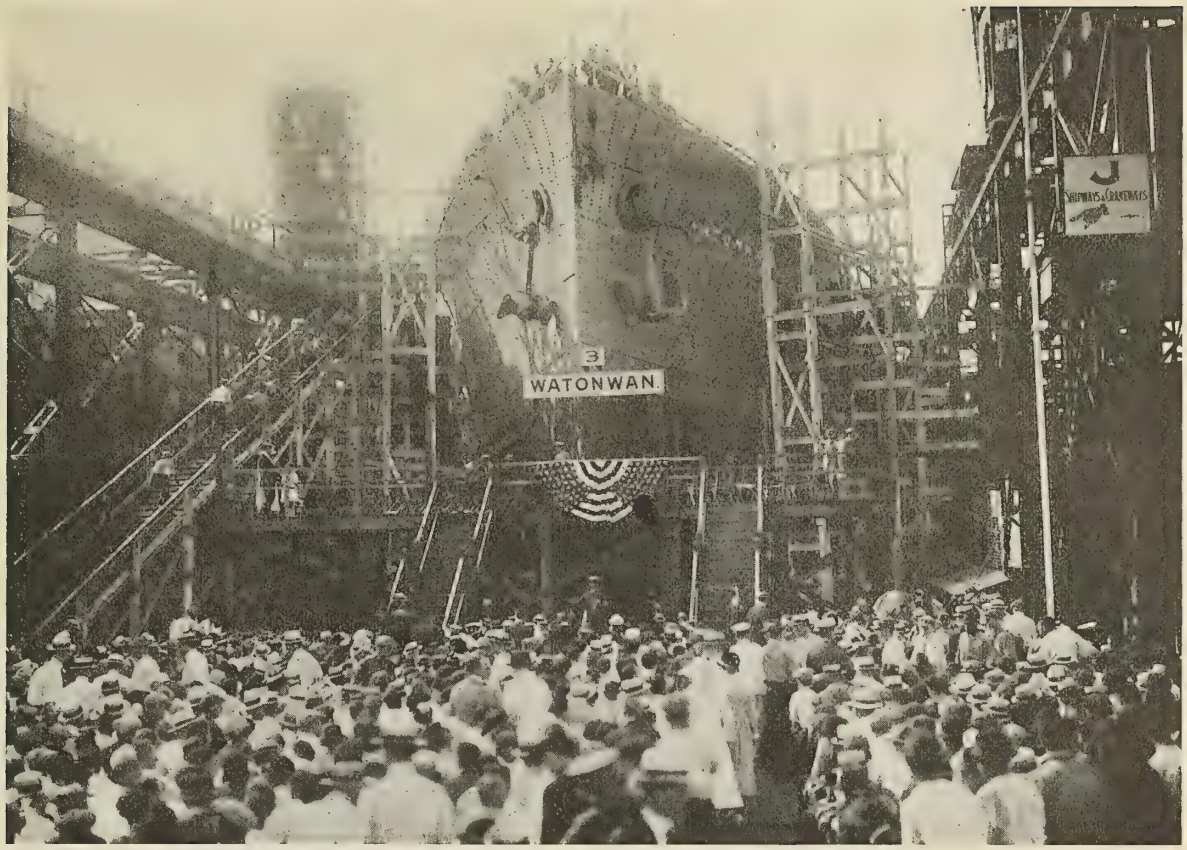
Now just watch and see if there are not a lot of men who will say that the story is true.

First Launching at Merchant Shipbuilding Yard, Harriman, Pa.

The ceremonies attendant upon the launching of the *Watonwan*, the first ship turned out by the Merchant Shipbuilding Corporation at Harriman, Pa., were unique among the launching festivities of the country in that they preceded the actual launching by some ten days. August 3 was the date set for the affair, and on that occasion over thirty thousand people were gathered at the Merchant yard to see the big carrier go over, but for some reason the vessel stuck on the ways and a postponement was necessary.

On August 14, however, the ship did go over, and the manner in which the launching was carried out won the admiration of men who have devoted their entire lives to the building of ships. At this time there were no special ceremonies except the christening, which was performed by Mrs. W. Averell Harriman, the wife of the chairman of the board of directors of the company.

The *Watonwan* is the first of a fleet of sixty vessels which is to be built at the Merchant yard, sixteen of which have been promised for delivery by January 1, 1919. General Manager D. D. Smith and his associates at the Harriman plant are bending every effort to fulfill this "sixteenship" promise that Mr. Harriman made to Director General Schwab some time ago, and there is every indication



S. S. *Watonwan* Ready for Launching at Merchant Shipbuilding Corporation Yard

at present that they will be successful, as the second launching is expected in the very near future.

The *Watonwan* is an 8,800-ton deadweight steel cargo carrier of the same type as the other vessels that are now under construction at the Merchant yard. The length of the load waterline is 400 feet 8 inches, while the other principal dimensions are as follows: Length over all, 417 feet 9½ inches; beam, 54 feet; depth to upper deck, 32 feet 10 inches; mean light draft, about 8 feet; load draft, about 25 feet; displacement at load draft, 12,214 tons; cargo capacity, about 7,400 tons.

The hull is designed upon the improved deep channel frame principle without stringers or other obstructions in the holds. Two rows of longitudinal deck girders are fitted 21 feet 6 inches each side of the center line. Pillars of heavy built-up columns are located along the center line of the ship, the load being transferred to same by transverse girders. A cellular double bottom extends all fore and aft, to be used for fuel oil or water ballast. Six transverse watertight bulkheads divide the hull into seven watertight compartments, including five cargo holds, the machinery space and peak tanks.

Propulsion is by a geared turbine of 2,500 shaft horsepower, driving a single propeller shaft at a speed of ninety revolutions per minute. Steam is furnished at a working pressure of two hundred pounds per square inch by water-tube boilers.

Mrs. Harriman Christening the *Watonwan*

The *Watonwan* Afloat

Letters from Marine Engineers

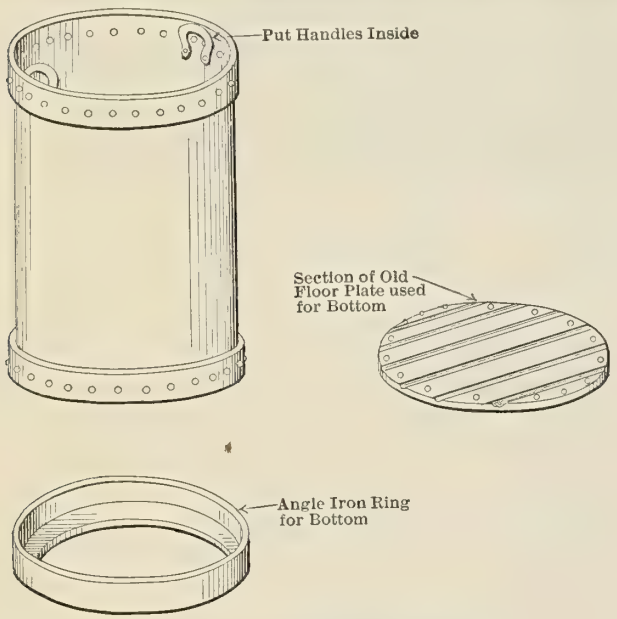
Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Durable Coal Bucket

While on a recent trip I stopped in at a small shop which was employed on some marine contracts. One of their jobs was that of making a thousand ship's coal buckets. Now this shop had always made small repairs and done overhaul work on marine vessels. One of their regular jobs also was that of refitting and renewing engine and boiler room floor plates. Consequently, they had on hand a large quantity of old floor plating.

When this order for coal buckets came along the foreman managed to save considerable steel plate by making



Details of Construction of Bucket

the bottom plate of the buckets out of these worn, smooth, misfit floor plates. Conservation of steel plate is a big thing, and such ideas are to be commended.

The details of these buckets are shown in the sketch. The placing of the handles inside saves them from being banged and broken, as they are when exposed on the outside.

C. H. Willey.

Official Uniforms for the Merchant Service

In a recent communication of mine, reference was made to the fact that men in the British merchant service are to have an official uniform.

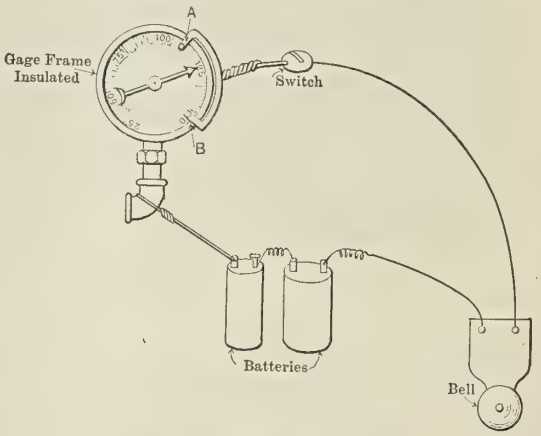
This is, of course, as it should be. Up to now there has been no official recognition of the mercantile marine; the commander of the *Lusitania,* for example, was legally master mariner and not entitled to the prefix "captain," nor had his gold braid any worth off his own ship.

The new uniforms just sanctioned will be confined to holders of Board of Trade certificates, either deck or engineer, and to surgeons, pursers and apprentices, as well as uncertificated junior officers qualifying for a certificate. Certain details have been fixed; the cap is to bear a gold admiralty anchor and naval crown surrounded by oak leaves, but the executive loop on jacket sleeve is withheld.

London. A. L. Haas.

Gage Alarm

This is a rather crude but no less useful manner in which an alarm signal for high and low pressure was made on an air compressor tank gage. The outside of the frame of the gage was insulated by a band of rubber



High and Low Pressure Alarm

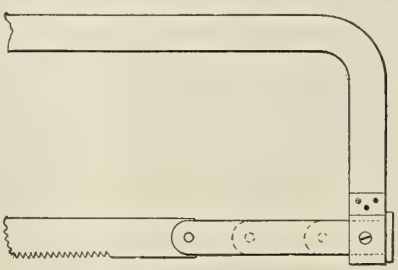
packing. The sketch roughly shows the scheme of wiring.

Perhaps the idea can be improved upon. However, this rough device serves its purpose at the place it was installed.

Engineer.

Arrangement of Hack Saw Handle to Hold Different Length Blades

In order to be sure of having a handle that will fit various lengths of hack saw blades, such as 8 inches, 10 inches and 12 inches, it is often necessary for the engineer



Attachment of Hack Saw to Handle

to carry in stock several sizes of handles which are cumbersome and take up considerable space. An arrangement for adopting one large handle to take the different size blades by merely changing one part is shown in attached sketch.

The end of the handle to which the outer end of the

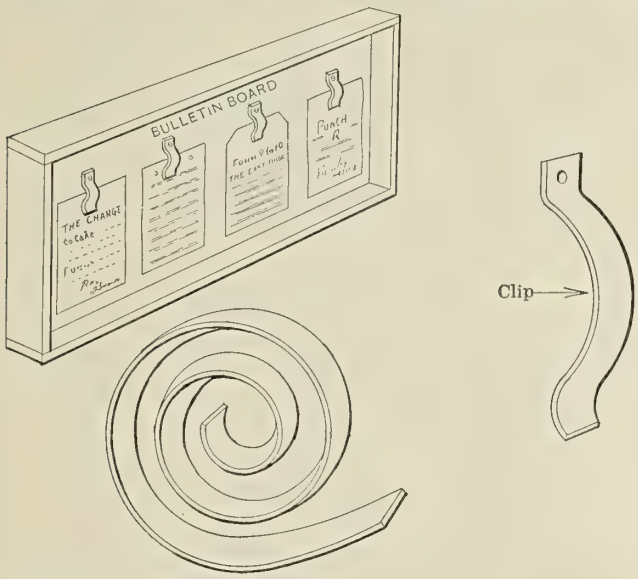
blade is attached is made removable, being held in place by a small screw. If a short blade is used, the long holder-end is inserted as shown in the sketch. If a medium length blade is used, say 10 inches, the long holder-end is removed and is replaced by a shorter end to accommodate the longer blade. In this way the single handle with the interchangeable length of holder-ends serves the same purpose as carrying three complete saw handles in stock.

Philadelphia, Pa. W. A. LAILER.

Bulletin Board Clips

The sketch shows a rather handy kink for the shop bulletin board—that of making spring clips to hold the various notices and bulletins.

The clips are quickly and easily made from an old clock spring. The holes in the clips are punched in with a



Clips Made From Clock Spring

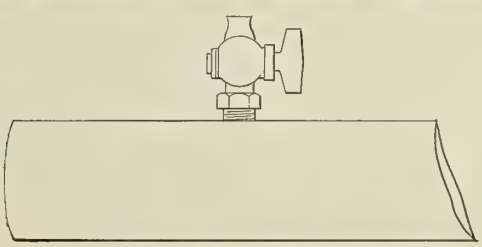
steel drift. Lay the section of spring on a hardwood block (end grain) and hit the punch or drift a sharp heavy blow. This punches a clean hole.

The clips are secured to the board with a small wood screw. For wide notices two clips work best.

MACHINIST.

Method of Detecting Leaky Traps

Where high pressure steam traps discharge into the open it is easy to maintain a watch on them to detect leakage.



Petcock Installed in Discharge Line of Trap

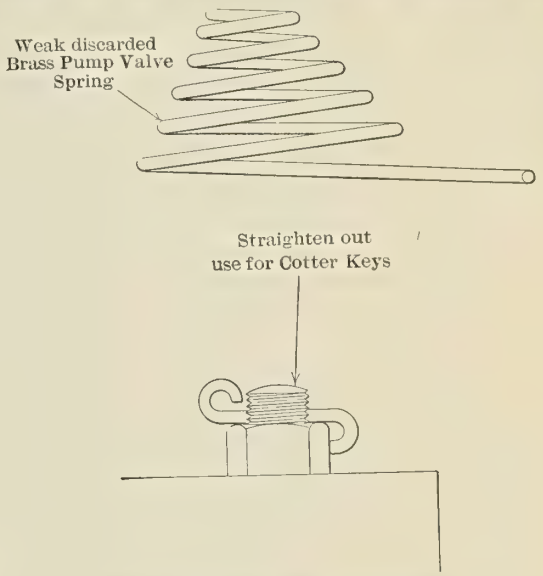
Where the traps discharge into a closed system the traps are liable to leak and waste steam for considerable periods without detection unless some means of checking them is used.

A simple tell-tale arrangement to show up excessive steam leakage past the trap is to install a petcock in the discharge line of the trap. If the cock is opened and only a light vapor rises from it, the operator can be fairly confident that no appreciable leakage is taking place.

On the other hand, if a considerable stream of steam emerges from the opened trycock, it is a sure sign that the trap is blowing and that it needs attention to eliminate the waste. ON WATCH.

Use for Old Springs

There are from time to time a lot of worn-out, or rather played-out, weak springs of round brass wire, something like the type shown in the sketches, to be

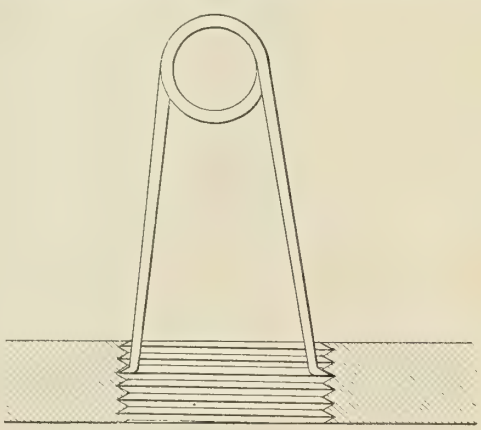


Cotter Key Made from Valve Spring

found in the pump valve chests. When these are taken out don't throw them into the scrap heap. Straighten out the coiled spring and use the wire for such purposes as cotter pins, etc. OLD SCOTCH.

Handy Tool for Cleaning Out Threads

In doing a considerable amount of piping work the writer has found that considerable time can be saved



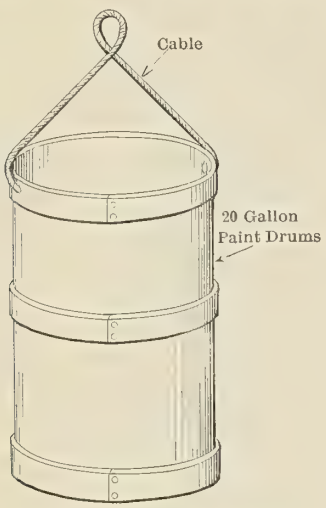
Spring Hook for Cleaning Out Threads

by starting out with clean threads. The time required thoroughly to clean off the threads is more than saved by the ease with which the pipe can then be fitted up.

For cleaning out the threads on the pipe a semi-circular wire brush is very effective in removing dirt, rust or grit. For removing the obstructions from the threads in fitting companion flanges, valves, etc., a simple spring hook as illustrated will be found very effective. L.

Light Weight Ash Bucket

While in dry dock we had the ashes of one live boiler, and those of twelve previously died out boilers, to get rid of in order to carry out the repair work. The regular ship's ash hoist buckets, made of heavy steel, were rugged and cumbersome to handle from the ship to the dock.

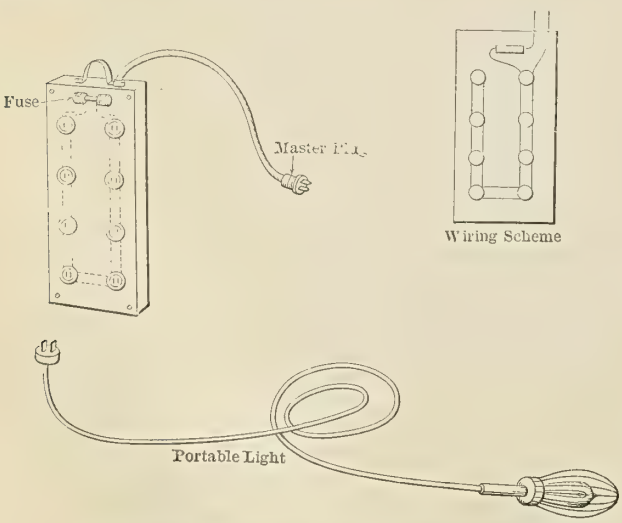


Ash Can Improvised from Empty Paint Drum

To make this work lighter, easier and quicker, the first assistant improvised a lot of light-weight ash buckets, such as shown in the sketches, using empty 20-gallon paint drums, plenty of which are to be had at a dock yard—the kind that ship's bottom paint comes in. The tops were cut out and a piece of cable used as shown. W.

Multiple Connector Board

This simple idea has been used in various ways in many plants and I have wondered why more engineers do not use it.



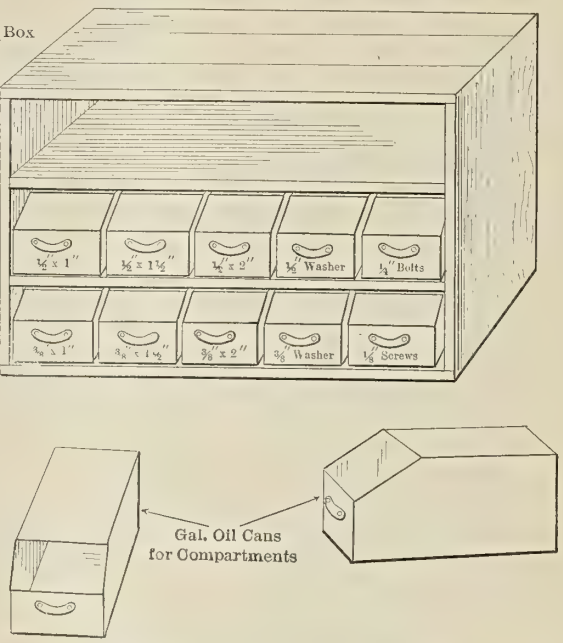
Multiple Plug Board for Portable Lights

Oftentimes it is necessary to use several portable lights such as when cleaning boilers, and perhaps an electric drill or other electric tools. Such a multiple plug board answers the need for plug connectors.

ELECTRICIAN.

Small Ware Container

A very handy and useful small ware container can be made from empty gallon oil or varnish cans by cutting the tops of the cans on the diagonal, as shown in the sketch.



Improvised Holder for Small Ware

This gives a wide opening, yet does not weaken the strength of the can so that it could be easily bent or pulled out of place. It also permits the contents of the container to be seen at a glance. An old packing box fitted up with a couple of shelves completes the contrivance.

F. W.

Letter Writing

To be able to write a good letter is perhaps one of the best assets that an engineer could acquire. While most of us can handle our actual practical duties aboard ship, when it comes to making up reports, requesting supplies, requisitioning repairs and making written recommendations regarding the need of certain changes, etc., for improving operating conditions, a good majority are up against it, simply because of never having given the subject of letter writing any share of time and study.

True, most ships have their yeomen, or clerks, and some of these are very proficient in paper work, and when an engineer finds one to whom he can dictate a rough draft of what he wants, the yeoman can manage to get out a decent letter. But how much better it is for one to be able to "get off his chest" what he wants to say and do it in a manner that reflects credit to himself and convinces those over him that he is master of his calling.

Perhaps the best way to cultivate the art is to practice until it becomes a habit to write well and interestingly Always make a rough copy of the letter and then read it over to test it; you will soon learn to detect your weak points and be able to correct them. Reading current en-

gineering journals, reports of societies, etc., will provide a means by which you can absorb the necessary engineering terms, phrases, style, composition, etc. You have no need to try and couch your letter in large technical words that sound learned and educated. Write as you would talk—plainly—convincingly—and try to draw the interest of your reader to the subject as deeply as you would were you speaking to him.

Letter writing has the advantage over oral recommendations in that you can lay the matter thoroughly before your superiors in black and white. You have a better chance to weigh your words, and they have a better opportunity to study out what you have said before they come to a decision.

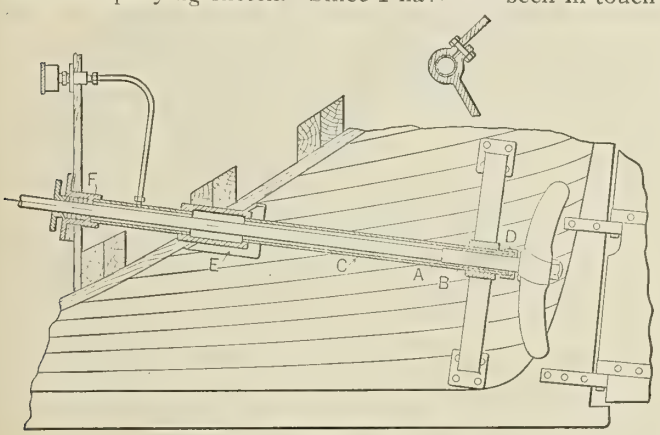
One very successful chief engineer of my acquaintance has developed a most efficient staff by requiring each of his subordinates to make to him quarterly written reports on all subjects of their respective departments.

One percent of their work is paper work, such as daily log reports, work job orders, machinery reports, condition of, etc., repair, requests, dock yard work, personal reports, fitness and other data. Suggestions and recommendations are also reduced to writing, each one going ultimately to the office files, and the result and credit of such suggestions and worth-while recommendations is given to the right party. This phase of engineering—the clerical phase, it might be termed—causes the men to study conditions more interestedly, and they become more proficient. Writing requires more concentration of thought on the subject at hand, and this produces better results in the end. Ex-Naval Engineer.

Device for Twin Screw Propeller Bearings

The article in the June issue of Marine Engineering, page 344, showing the excessive wear which may result from the friction of sand in the strut bearings of a twin screw propeller, serves to emphasize the fact that few designers are taking any precaution against this common fault of the twin screw installation.

The arrangement which I have used on some twin screw motor installations for fishing vessels is shown in the accompanying sketch. Since I have not been in touch



Section Through Stern Tube

with the owners recently I have not had the opportunity to hear of any trouble experienced. The last installation of this kind, however, which I made on my own auxiliary yawl three years ago has proved entirely satisfactory. When the shafts were removed for inspection last winter I found that not even a drop of water had entered the stern bearings or tubes, much less a particle of grit, although the boat has been operated almost entirely in shallow water.

The sketch submitted shows the details of the installation in my own boat. The two propeller shafts are of steel driven by sprocket chains from one engine placed amidships. Each shaft is provided with one brass sleeve, *A*, in the bearing bushing, *B*, which is made of babbitt. This bushing is slipped into the bronze pipe, *C*, and held in place by a pipe cap, *D*, through the head of which a hole has been bored to clear the brass sleeve on the shaft. By this means the flange of the bushing is securely held in place clamped between the cap and the end of the pipe. The pipe, *C*, is screwed into the bronze casting, *E*, fitted to the side of the boat, and the bearing end of the pipe is clamped by the split hub of the strut, thus making the renewal of the pipe easy in case of injury. Another pipe of the same size is screwed into the inboard end of the casting, *E*, and connected with the stuffing box, *F*. The inboard pipe is tapped for a ⅜-inch pipe or copper tube which connects with a grease cup on the bulkhead placed at the waterline. After the interior of the pipes and fitting has been filled with soft grease and flake graphite the shaft is pushed through. The grease which is forced out of the pipe due to the displacement of the shaft may be caught in a pan and used for future lubrications in the grease cups. The packing in the stuffing boxes prevents the grease from being forced inboard; therefore all the surplus which is forced out into the tubes is gradually squeezed out through the stern bearing, thus preventing anything from entering the latter. Due to the use of this grease packing the stuffing box need not be set up tight, consequently the friction is reduced to a minimum.

The packing which I put in three years ago is still in service. The stuffing boxes have been disturbed only when the shafts were removed for inspection last winter. This inspection revealed that not even the tool marks had worn on the brass sleeves, the use of which was considered necessary to prevent the shaft at the propeller hub from corroding. The extra cost of the installation which I have described over that in common practice is but slight, and it soons pays for itself in repairs, packing and power gained by the elimination of friction.

Jersey City, N. J. H. E. A. Raabe.

Record Ship Completion

The *London Daily News* of June 10, 1918, publishes the following:

A new record in shipbuilding has been created at the yard of Messrs. Workman Clark & Co., Belfast.

A standard ship of over 8,000 tons has been completed in readiness for sea in 15 working days after launching. The previous best time record for a similar vessel was 19 days. Eleven hours after the ship was launched her engines and boilers were shipped and put in position.

London. A. L. Haas.

Who Does the Work?

In the days when the artist had to grind his own paints, a group of people were watching a celebrated artist at work and were exclaiming over the hard work he had done. This was too much for the Irish servant of the artist.

"Him doing hard work? Why every ounce of paint on that there picture I ground with me two hands, and all he had to do was to shove it on the canvas wid a small brush. I did all the work, not he."

This idea seems to be held by a number of workmen to-day. They think because they drive the rivets, punch the plates, or machine the parts that they are the whole push, and the brains of the boss count for nothing.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

CONDUCTED BY H. A. EVERETT

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

There will appear in this column from time to time questions which have been asked by the Board of Steamboat Inspectors in the various examinations for engineers' licenses conducted by them. Such questions will be denoted by an asterisk (*) placed before the number if from examination for grade of chief, and by a dagger (†) if from examination for other grades.

Steering Gear Problem

Q. (970).—In a steering head 18½ inches in diameter without any allowance for draw, but with the cross arm 1 inch off center, how should the rudder stock be prepared to receive the head? It appears that the designer might have intended that 2-inch draw could be obtained by shaping the rudder stock so as to put the center of the shaft support (or box) in the true center of the stock. If this is not correct, how could the head be placed on the stock with the necessary draw to hold it securely?

The second point in question is what would happen if 2 inches are removed from one side of casting and the shaft supporting box thrown 1 inch out of center? Should this condition exist in order to make the steering gear work to the best advantage, or should the center of the shaft supporting box be in the exact center of the stock?

For a description of the Robinson steerer see Hyde Windlass Company's catalogue, page 74.

A. (970).—When properly installed, the gear you mention should have the center of the cross arm a short distance off center from the rudder stock. This is to compensate for the unequal lengths of the arms to the screw threads. As the ends on the screw threads move equal

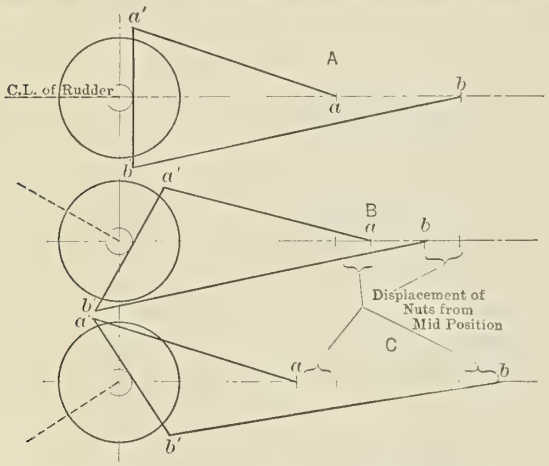


Diagram Showing Action of Steering Gear

distances when the steering wheel is moved, the movement of the ends attached to the cross arm would be unequal, because of the inequality of the arms, unless some compensation were provided. This is done by locating center of the cross arm off center from the rudder stock so that as the rudder is put over the center moves with it sufficiently to equalize the irregularity due to the inequality of the arms.

The figures show this gear diagrammatically; *A* with the rudder amidship; *B* with the rudder about 30 degrees to port, and *C* with the rudder about 30 degrees to starboard. In going from *A* to *B* the nuts on the screw threads (*a*) (*b*) have traveled equal distances, and thus the other ends *a'* and *b'* of the connecting links move unequal distances, and would tend to bend the link *a'*-*b'* unless it were located as shown to compensate this irregularity by its eccentric motion.

Proportions of "Ideal" Cargo Vessel

Q. (972).—In the rebuilding of the American merchant marine is there any tendency in the design of cargo carriers to change radically their dimensions as to length, beam and depth (loaded) from designs of pre-war times, in an endeavor to evolve what may be termed an "ideal" cargo carrier? In other words, is there any tendency to change the proportion of width to length, or depth to width, in the new designs?

(2) Is there a rule or method by which, given the length and beam of a cargo boat, one may roughly approximate its draft, loaded? If so, please explain.

(3) Is there, in your opinion, what may be termed an "ideal" cargo carrier, as to length, beam and depth, representing the maximum on the credit side (earning power) and the minimum on the debit side (construction, operation and maintenance costs)? For example, would a cargo boat the size of the *Leviathan* (formerly the *Vaterland*), every consideration being regarded, be more suitable than a smaller boat, or a number of smaller boats?

A. (972).—(1) There is no radical departure from the proportions existing before the war.

(2) Assuming that you know what the total weight, or displacement, of the ship is to be in the loaded condition you may estimate the draft from the following relationship:

$$\text{Displacement} = \frac{\text{Length} \times \text{beam} \times \text{draft}}{35} \times \text{block coefficient.}$$

Displacement is in tons (2,240 pounds) and the linear dimensions in feet. The block coefficient of modern freighters is from 0.70 to 0.80, and for passenger ships, 0.60 to 0.65.

If the load displacement is not known, it must first be estimated. Pure cargo vessels of low speed usually carry a deadweight (cargo, fuel and stores) approximately twice their weight, which may help you to estimate total displacement, if you know the deadweight carrying capacity. This only holds, however, for the type of boat mentioned.

(3) The dimensions and type of the "ideal ship," as you call it, are purely a function of the character of route and cargo. We are almost always limited to a certain *draft,* governed by the harbors between which the ship plies. With this fixed the *beam* becomes fixed by considerations of stability and this leaves *length* as the only element in which the designer has much latitude. This should be chosen only when the considerations of initial cost (which includes power for the speed desired), character of route and cargo are carefully investigated. Obviously the vessels intended to carry ore or rails need different characteristics from one intended to carry grain or light package freight.

To hit an all round cargo carrier which will be satisfactory for a wide variety of uses the United States Shipping Board are now building two standardized cargo vessels, one to carry 7,300 tons deadweight and the other about 3,000 tons deadweight. The first is 385 feet length by 53 feet beam by 24 feet load draft, speed 11½ knots, and the second of similar proportions but smaller and slower. Great Britain has standardized on three sizes of 3,000, 5,000, and 8,000 tons approximate deadweight carrying capacity. A complete description of the United States

standard 7,300 ton ship appeared in this magazine, August, 1917, and probably this is as near a specific answer as can be given to your inquiry.

NEW BOOKS

Composition of Technical Papers. By Homer Andrew Watt, Assistant Professor of English, New York University. Size, 4⅞ by 7¼ inches. Pages, 431. New York, 1917: McGraw-Hill Book Company. Price, $2.

"An engineer who is inarticulate is quite as useless as one who is professionally incompetent." The very basis of any scientific work necessarily implies ability to give ideas in clear form to those who are responsible for their comprehensive execution, and many successful men realize this limitation long after they have finished the *formal* education which should have provided it. Professor Watt has accordingly prepared a textbook for college use, to supplement the general English course by specific instruction in the composition of technical papers.

A Practical Course in Wooden Boat and Ship Building. By Richard M. Van Gaasbeek, Head of Woodworking Department, School of Science and Technology, Pratt Institute, New York. Size, 4¾ by 7 3/16 inches. Pages, 204. Illustrations, 168. Chicago, 1918: Frederick J. Drake & Company. Price, $1.50, net.

To meet a popular demand for a textbook to assist house carpenters and woodworkers in transferring from their usual occupations to the wooden boat and ship building industries, and especially for those men who wish to qualify for advanced positions and for boat and ship builders who wish to broaden their experience in order that they may prepare for greater responsibilities, this work is offered.

The text is the outgrowth of a pioneer course organized by Pratt Institute early in the war along the lines outlined in another section of this issue of Marine Engineering. The first part of the work is strictly technical in character, giving operations in sequence as they were performed on the job and explaining them in such a way that the average mechanic can understand. In the second part an effort is made to show typical ship construction views, giving the reader an idea of the methods of handling and fastening heavy timbers. Of the 168 pertinent illustrations, 50 are official photographs showing methods of construction and handling the work on wooden ships now being built for the Emergency Fleet Corporation.

The subject is divided under the following heads: The Mold Loft, Stem and Stern Construction, Futtocks and Frames, Outside Planking, Ship Construction, Machines and Labor-Saving Devices, Raising the Frames, Planking and Finishing, Hand Tools Used in Wooden Boat and Ship Building, Shipbuilding Terminology.

The Elements of Navigation. New and Enlarged Edition. By W. J. Henderson, A.M., formerly Lieutenant in the First Battalion Naval Militia, of New York. Size, 4 by 6 inches. Pages, 237. Illustrated. New York, 1917: Harper & Brothers. Price, $1.25, net.

In the new edition, this little volume is brought up to date by including the use of the present nautical almanac and tables recently added to Bowditch's *Practical American Navigator,* the latest navy method of marking compasses and of setting and correcting courses thereby, and methods of computing a constant for meridian sights. The scope of utility for the ϕ' and ϕ'' sight for latitude has been enlarged; new tables to facilitate the use of the moon have been added; the new nautical almanac method of latitude by Polar Star is treated; the important Saint Hilaire method of fixing a position on a Summer line by comparison of a computed and actual altitude is explained; the latest form of navy log is presented, and the book is well-rounded by the addition of a new chapter covering the daily routine of the navigator's work from leaving his port of departure to entering his port of destination.

Ports and Terminal Facilities. By Roy S. MacElwee, Ph.D., Lecturer in Economics and Foreign Trade, Columbia University, Associate Member of the Society of Terminal Engineers and American Association of Port Authorities. Size, 6 by 9 inches. Pages, 315, including over five pages of carefully prepared bibliography. Illustrations, 117. New York, 1918: McGraw-Hill Book Company, Inc. Price, $2.

What *does* make a successful port? Engineers, port officials, business men and other progressive citizens are awakening to the fact that expensive harbor works alone, no matter how well constructed, do not make a port which will succeed in bringing commerce and wealth to a city. There are complex ramifications and subtle interrelations or economic causes which determine the prospects of success of a port. At this time the need for better port and terminal facilities is not only a vital war measure, but of continued and increasing importance in securing to the United States its place as a leading maritime power after the war.

It has been Dr. MacElwee's endeavor to point out in this condensed volume some of the factors which enter into the problem. The material, originally presented in lecture form for the course on "Ports and Terminal Facilities" recently given at Columbia University, has been revised and published with a view to stimulating further investigation, study and analysis of port problems, and to bringing about a better understanding on the part of the general public of the importance of the subject to the nation and the community.

The interest of the writer in ports extends back through nearly a score of years of travel and business abroad, with intensive study of the question during the last six years as head of the Hamburg office of an American firm that built elevators and hoisting machinery. With this background upon which to base intelligent discussion, the chapters on "Piers and Quays," "Wharf Equipment" and "Cargo Tranfer and Handling" contain the maximum of definite information and criticism upon efficient wharfing facilities. The various efficient developments in wharf structure resulting from the conditions existing at the free ports of Hamburg and Bremen are compared with the South Delaware Wharves, Bush Terminal (New York) and the newest methods at the proposed Moyamensing Piers (Philadelphia) under the definite headings *Size of Transit Sheds, Railroad Freight, Car Tracks, Location of Tracks, Teams and Motor Trucks, The Two-Deck Pier,* and *Length of Piers.* In the chapters on "Cargo Transfer and Handling" and "Shed Equipment," the various types of portable conveyors, new cargo masts, heavy-duty cranes and the adaptation of these appliances to varying wharf capacity are illustrated and discussed along the lines already developed by H. McL. Harding and others in recent issues of Marine Engineering.

At this time it behooves America so to develop her potential wharf facilities that they provide for maximum loading and unloading in minimum time. A complete understanding of the principles underlying all well-planned wharves, as Dr. MacElwee has outlined them, and the application of many devices for efficient handling of cargo will go far toward utilizing our possibilities to the fullest extent.

Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements—Engineering Projects—Improved Appliances—Personal Items

SHIPPING BOARD ORDERS MORE WOODEN SHIPS

Contracts Closed With Coast and Lake Shipbuilders for Steamships, Barges and Harbor Tugs

The United States Shipping Board has awarded contracts as follows for 34 wooden cargo vessels, 7 wooden barges and 3 wooden harbor tugs:

Two wooden cargo vessels, 3,500 tonnage, Fulton Shipbuilding Company, Mormon Channel, Wilmington, Cal.

Two wooden cargo vessels, 3,500 tonnage, Seaborn Shipyards Company, Tacoma, Wash.

Two wooden cargo vessels, 3,500 tonnage, St. Helens Shipbuilding Company, St. Helens, Ore.

One wooden cargo vessel, 3,500 tonnage, George F. Rogers & Company, Astoria, Ore.

Two wooden cargo vessels, 3,500 tonnage, Nilson & Kelez Shipbuilding Corporation, Seattle, Wash.

Five wooden barges, 2,500 tonnage, Coastwise Shipbuilding Company, Baltimore, Md.

Six wooden cargo vessels, 3,500 tonnage, Kruz & Banks Shipbuilding Company, North Bend, Ore.

Three wooden tugs (harbor), Leathem & Smith Towing & Wrecking Company, Sturgeon Bay, Wis.

Eighteen wooden cargo vessels, 3,500 tonnage, Universal Shipbuilding Company, Houston Ship Canal, Harris County, Tex.

Two wooden barges, 2,500 tonnage. This contract supersedes and cancels former contracts with Universal Shipbuilding Company.

ADDITIONAL CONTRACTS

In addition to the above, the Shipping Board has awarded the following contracts for wooden vessels: Midland Bridge Company, Houston, Tex., George E. Cole, general manager, four 5,000-ton steamships, two 3,500-ton steamships and four 2,500-ton steamships; The Wright Shipyard, Tacoma, Wash., two of 3,500 tons; John W. Fahey, Jacksonville, Fla., four of 3,500 tons, and Kiernan & Kern, Portland, Ore., four of 4,500 tons.

Capital Invested in Shipbuilding and Shipping During War Totals $445,154,000

The authorized capital of shipbuilding companies organized in America during the nineteen months ending August 1 amounts to $198,350,000, and the capital of other shipping concerns organized during the same period amounts to $73,103,000. The new capital invested in shipbuilding and shipping enterprises for the entire war period (since August, 1914) amounts to $445,154,000.

Shipbuilding Contracts Awarded by the Shipping Board

Among the contracts recently awarded by the United States Shipping Board are the following:

To Skinner & Eddy Corporation, Seattle, Wash., 35 steel steamships with a deadweight tonnage of 332,800.

The Mobile Shipbuilding Company, Mobile, Ala., D. R. Dunlap, president and general manager, 12 steel steamships with a deadweight tonnage of 60,000.

To K. M. Murdoch, Jacksonville, Fla., six wooden steamships with a deadweight tonnage of 21,000.

To the Missouri Valley Bridge & Iron Company, Quantico, Va., seven wooden steamships with a deadweight tonnage of 24,500.

To the Continental Shipbuilding Corporation, Yonkers, N. Y., one wooden steamship with a deadweight tonnage of 1,500.

The Schaw-Batcher Shipbuilding Company, South San Francisco, Cal., has under construction eighteen 8,800 deadweight ton freight ships for the United States Shipping Board.

It is reported that the Todd Dry Dock & Construction Corporation, Tacoma, Wash., has received contracts to build twelve more 7,500-ton steamships.

The Long Beach Shipbuilding Company, Long Beach, Cal., has a contract to build eight 8,800-ton steel steamships.

The Ames Shipbuilding & Dry Docks Company, Seattle, Wash., has a contract to build fourteen 8,800-ton steel steamships.

The Northwest Engineering Works, Green Bay, Wis., will build six steel, ocean-going tugs.

New Shipbuilding Contracts

The South Bend Shipbuilding Company, South Bend, Ore., has received a contract to build four topsail schooners, each 2,200 deadweight tons.

R. L. Bean, Camden, Me., will build three wooden four-masted schooners, each to be of 1,150 gross tons.

The Gulf Shipbuilding Company, Houston, Tex., G. A. Alonze, president, has received a contract to build several steel oil barges, each with a carrying capacity of 30,000 barrels.

Thomas G. Greenlaw, Harrington, Me., is building three five-masted schooners.

The Portland Ship Ceiling Company, Portland, Me., is building six 3,500-ton wooden ships for the United States Shipping Board.

More Steel for Shipbuilding

At a recent meeting of the War Industries Board, Charles M. Schwab, director general of the Emergency Fleet Corporation, and Edward N. Hurley, chairman of the United States Shipping Board, made a request for an additional allowance of steel plates to carry out the Government's shipbuilding programme.

In addition to an amount of about 50,000 tons of plates per week, regularly furnished for shipbuilding purposes, Mr. Schwab asked for the delivery of an extra 10,000 tons a week during the next three months to serve as a reserve during the winter period.

GOVERNMENT PROPOSES DEVELOPMENT OF INLAND WATERWAYS

Barges and Tugs to Be Built—River and Canal Terminals to Be Provided

New plans of the Government include comprehensive methods for improving inland water traffic. Congress granted authority to the Railroad Administration to use the revolving funds of the rail lines to improve and develop inland water transportation. Acting under that provision of the law the Railroad Administration has already appointed a manager for the New York and other Eastern canals and inland waterways, and a manager for certain Southern waterways around New Orleans.

The Shipping Board has promised to use its facilities for the construction of barges and tugs and similar equipment for these canals and rivers. Government funds and railroad funds will be tied up in these new properties. Furthermore, the new inland water lines will be operated not in competition with the rail lines but as adjuncts to them.

Slow-moving freight, bulk goods and similar traffic can be moved over the water routes, and the rail lines reserved for the package business and the fast-moving freight. It is reported to be the intention of the Railroad Administration to link up all the inland waterways, equip them and operate them in connection with the railroads. When this scheme of inland water traffic is fully developed it will be possible to load a barge at New Orleans, ship it up the Mississippi River to Chicago, and on down East to New York, Philadelphia or any of the Atlantic ports, without once unloading it.

PORT FACILITIES

Another drawback to inland water traffic heretofore has been the lack of terminals. In New York, for instance, it has been very difficult to find terminal space for canal and river lines. With the unified management under the Government it is possible to permit these inland water lines to use the terminals of the railroads. At ocean ports it may be possible to use the docks of the Emergency Fleet Corporation.

This offers a great opportunity to the inland water lines, and one which traffic officials are anxious to take advantage of.

AMERICA LEADS IN SHIPBUILDING

New Yards Rapidly Nearing Completion—Extensive Additions to Old Yards

At the time of our entrance into the war there were 37 steel shipyards in America. To-day there are 72, and the old yards have been enlarged from a capacity of 162 ways to 195, and more are being added. The 24 wooden shipyards of 1916 have been increased to 80 in 1918.

Results, however, are the measure of production, and the launching of 95 steel and wooden hulls July 4 brought home to the nation at large the fact that America has become the greatest shipbuilding country in the world.

Of the 162 shipbuilding plants in the United States, 118 of them are practically complete. And of this number 53 are new yards constructed since our declaration of war. Of the 46 yards still in process of construction, 25 are between 75 percent and 100 percent completed; 3 between 25 percent and 50 percent completed, while only 6 are less than 25 percent completed.

Among the 45 yards under construction are the 4 so-called fabricating yards at Hog Island, Bristol, Wilmington, N. C., and Newark Bay, N. J. Hog Island, the modern epic in shipbuilding, is almost completed, and within a few days its 50 ways will begin to pour an almost daily stream of hulls into the Delaware River. Bristol, with its 12 ways, is virtually a finished yard. The assembling plant of the Carolina Shipbuilding Company was commenced in May and still is in its infancy.

Wherever expansion can be made efficiently, the United States Shipping Board Emergency Fleet Corporation is lending its aid to increase the capacity of American shipyards. The Alameda plant of the Bethlehem Shipbuilding Corporation in California has been authorized to add 10 new ways at an estimated cost of $20,000,000. Their Sparrows Point yard in Maryland is adding 3 additional ways at an estimated cost of $3,000,000. The New York Shipbuilding Corporation, Camden, N. J., is building 5 additional ways at an estimated cost of $7,000,000.

Although these figures show the tremendous work accomplished in building our shipyards, they give but the slightest hint of the stupendous task that has been completed in bringing this end of the nation's shipping programme to its triumphant accomplishment. "It took Germany 40 years to build up her military machine," said Chairman Hurley. "In less than eight months we have built up a shipbuilding machine which, when it gets into full swing, will defeat the military machine of Germany."

French Ships of Large Tonnage Proposed

On August 4, the French Chamber gave approval to a plan which, if carried out, will make France one of the great maritime powers of the world. M. Buisson, Commissioner of Maritime Transports, said he proposed to ask $400,000,000 to develop French shipping on an adequate scale. Great boats of the *Leviathan* type must run between the United States and France.

What France needed, M. Buisson concluded, was a State mercantile fleet. Andre Tardieu, the French High Commissioner to the United States, who also spoke from the floor following M. Buisson, said that France could count upon the whole-hearted support of the United States.

Bethlehem to Build New Shipyard on the Pacific Coast

With the Victory plant at Squantum completed and boats being launched there every few days, the Bethlehem Shipbuilding Corporation has again turned its attention to further expansion, and authorized the construction of a new shipyard located at Alameda, Cal., near the present plant of the Union Iron Works.

A contract for the construction of the plant was awarded to the Aberthaw Construction Company, of Boston, who recently completed the Victory plant in record time, and who has handled practically all the wartime expansion of the Bethlehem Corporation, totaling more than $20,000,000, exclusive of the present work.

The Alameda plant will be the second largest in the United States, exceeded in size only by Hog Island. It will be twice the size of the Victory plant at Squantum and will involve twice the expenditure. The plant, which will be complete for building on ten slips, will cover over a third of a square mile, and from three to four million yards of dredging will be necessary. Large cargo vessels will be constructed, contracts for which have already been awarded to the Bethlehem Shipbuilding Corporation by the United States Shipping Board.

The formal opening of the work occurred on August 13, when the first pile was driven, and there was a big celebration, with addresses by Mayor Green, of Alameda, W. H. Ryerson, of the Aberthaw Construction Company; Mr. Ely, of Monks & Johnson, of Boston, the architects and engineers, and by several representatives of labor, who pledged their hearty support. Five hundred men are already on the grounds, and it is anticipated that the construction work will require the services of approximately 15,000 men within the next few weeks.

More Marine Engineers Needed

The Sea Service Bureau of the United States Shipping Board Recruiting Service reports urgent need of first and second assistant engineers to serve on ships of the merchant marine.

Men holding licenses in these grades have only to address an application to the Sea Service Bureau, United States Shipping Board Recruiting Service, to secure employment at sea. There are no fees for signing on through this bureau.

There was never a time when the rewards for service to a marine engineer were so great as now, both in actual pay and in the chances for rapid advancement.

If some of the new ships are to be moved without serious delay, it is necessary that a considerable number of first and second assistants come forward at once for duty at sea.

NEW SHIPYARDS AND EXTENSIONS OF EXISTING YARDS

Additions, Improvements and Orders for New Equipment

The Great Northern Concrete Shipbuilding Company, Vancouver, Wash., has begun work on its shipyard. This company has received contracts to build five ships for the United States Shipping Board.

The Fabricated Ship Corporation has been organized in Milwaukee, Wis., to build steel steamships. Samuel C. Coddington, of the Lakeside Bridge & Steel Company, North Milwaukee, is treasurer of the new company. George C. Newton is in charge of the chemical plant and equipment of yards and ship construction. Thomas J. Baker is in charge of shipyard construction and outfitting. Alfred L. Newton is chief purchasing officer, and Julius Thielacker is superintendent of steel erection.

The Great Lakes Engineering Works, Detroit, Mich., James S. Keightly, purchasing agent, announces it will more than double its shipbuilding plant at Ashtabula, Ohio.

The Southern California Shipbuilding Corporation, recently organized at Los Angeles, Cal., is planning the construction of a plant at Los Angeles Harbor. Hamilton W. Barnard, A. E. Cromweed, W. M. Carpenter, F. H. Wells and Henry Prince, Los Angeles, and Henry J. Morton, San Francisco, will head the company.

The Terry-Tench Contracting Company, Grand Central Terminal, New York, has organized the Terry Shipbuilding Corporation, and will build a shipyard in Long Island City. It is stated that the company has already received a contract to build twenty barge canal boats.

A corporation has been formed in Quebec, Canada, capitalized at $5,000,000, to take over the Federal Shipbuilding Company, Sarnia, Ont.; the Dominion Shipbuilding Company, Collingwood, Ont.; Dussault & Hutchinson, Levis, Que., and a number of smaller interests. It is stated that the new company will build steel steamships for the French Government.

The Lake & Ocean Shipbuilding Company has been organized at Cleveland, Ohio, to build ocean-going tugs. The company is stated to have already received a contract to build three 150-foot tugs for the United States Shipping Board. James Craig, vice-president and general manager of the National Iron & Wire Company, of Cleveland, is president.

The Greenport Ship Company has been organized in Greenport, N. Y., by W. T. Thompson, G. T. Low and W. A. Sweet, 45 Cedar street, New York.

It is reported that the Federal Shipbuilding Company, Kearney, N. J., will build a dry dock and shipyard to cost more than $8,000,000, on property recently acquired on the Hackensack River.

The Port Arthur Iron Works, Port Arthur, Tex., Francis G. McEwan, manager, will build a plant to repair barges and tugs.

The Adams & Eddington Shipbuilding Corporation has been organized at Port Arthur, Tex., to build concrete ships.

The West Coast Shipbuilding Company, Portland, Ore., H. E. Spear, president, has purchased the yard of the Naull Ship Company at Wilmington, N. C., and will add facilities to construct concrete barges. It is reported that a $1,000,000 order has already been received from the Government to build such barges.

The Union Shipping Company has been organized at Biloxi, Miss., to build wooden steamships. L. T. Hance is manager.

James W. Black and associates, 347 Madison avenue, New York, have organized a company to build concrete barges at Plaquemine, La.

The Ancote Shipbuilding Company has been organized at Tarpon Springs, Fla., and will build a yard for the construction of wooden ships.

The American Lumber Company, Panama City, Fla., has given a contract to the Bates & Rodgers Construction Company, 37 West Van Buren street, Chicago, Ill., to build a shipyard at Millville, Fla. The company has a contract from the United States Shipping Board to build eight 2,500-ton wooden barges. The American Lumber Company was formerly known as the German-American Lumber Company, and is now under Government custody.

The Jahncke Shipbuilding Company, New Orleans, La., E. L. Jahncke, president, will build additional dry docks under a contract from the Emergency Fleet Corporation. The company will also build several 2,800-ton auxiliary schooners.

The Weehawken Dry Dock Company, foot of Baldwin avenue, Weehawken, N. J., is planning to build a shipyard at Peekskill, N. Y.

The Rahberg Dry Dock & Repair Company has been organized by H. W. Ramberg, F. Schmidt and C. Sendixen, 51 Seventy-fifth street, Brooklyn, N. Y.

The Barber Asphalt Paving Company, 233 Broadway, New York, will build a plant at Mauer, near Perth Amboy, N. J., for the manufacture of marine boilers.

The Todd Shipyards Corporation, 15 Whitehall street, New York, according to report, will increase the capacity of all of its shipyards.

The Mid-West Shipbuilding Corporation has been organized at De Pere, Wis. The incorporators include E. G. Mohr, John A. Littell and W. W. Callaher, all of De Pere.

The Slidell Dry Dock & Shipbuilding Corporation, Slidell, La., has acquired property with the intention of constructing a plant to build steel vessels. A. D. Canulette is general manager.

Doullut & Williams Shipbuilding Company, New Orleans, La., will equip a first unit to build steel vessels. The plant will be tripled as quickly as material and machinery can be obtained.

A controlling interest in the Patterson-MacDonald Shipbuilding Company, and an interest in the Seattle North Pacific Shipbuilding Company, Seattle, Wash., has been purchased by James Black, of the Black Masonry & Contracting Company, St. Louis, Mo. The Seattle North Pacific Shipbuilding Company was formerly the Erickson Engineering Company, and is building a large steel shipbuilding plant. The Patterson-MacDonald Shipbuilding Company builds wooden vessels, and is now building ten 4,200-ton ships for the Australian Government.

The Victory Steamship Company has been organized to establish a shipyard and repair works. The incorporators are M. C. Sullivan, 109 West 183d street, New York; B. B. Meade, 1999 Washington avenue, New York, and M. W. Sametz, 672 Park Place, Brooklyn.

The Supple-Ballin Company, Portland, Ore., Joseph Supple, president, will build a large outfitting dock for vessels constructed for the United States Shipping Board. It is stated that it will cost $200,000, and that it will accommodate ten hulls at a time.

The Port Arthur Iron Works, Port Arthur, Tex., is planning the construction of a plant for building and repairing tugs, barges, etc.

The Union Shipbuilding Company, Fairfield, Md., has purchased a 400-foot waterfront and will build an addition to its plant.

The Howard Shipyards & Dock Company, Jeffersonville, Ind., will rebuild its shipyard at Paducah, Ky., which was recently burned.

It is reported that Capt. George J. Pilkington will build a shipyard at Miami, Fla., for the construction of wooden vessels, and that he already has a contract from the United States Shipping Board to build two ships.

The United Shipbuilding Company has been incorporated at Portland, Ore., by J. Cassidy, J. Tierney and J. Devine.

The Pacific Marine Iron Works, Portland, Ore., has received a contract for the Sommarstrom Shipbuilding Company, Columbia City, Ore., to fit out six ships.

The Barling Shipbuilding Company has been incorporated by C. A. Barling, P. Svendsen and E. A. Trik, 205 Seventy-first street, Brooklyn, N. Y.

It is reported that J. J. Schultcher has organized a company at Beaumont, Tex., to build wooden barges.

It is reported that the Gulf States Shipbuilding Company, recently organized, will build a large shipyard at Orange, Tex.

The Russell Shipbuilding Company has been organized at Portland, Me., by F. A. Rumery, R. Payson and M. S. Newcombe.

The Kennebunk Shipbuilding Company has been organized at Kennebunk, Me. William H. Mahoney is president and William H. Culliver is treasurer.

The Queensboro Boat Works, Inc., has been organized by C. Bohn, P. W. Moore and A. S. Honig, Long Island City, N. Y.

Bethlehem Steel Speeds Up Shipyards

At a recent meeting of the stockholders of the Bethlehem Steel Corporation, President Eugene G. Grace mentioned the following facts, which give a very concrete idea of the activity of the corporation in shipbuilding development:

"We have 65,000 employees engaged at the various shipyards, compared with about 40,000 in May. Our new Liberty plant at Alameda, Cal., will come in about the middle of 1919, and this will require 10,000 additional shipworkers.

"The destroyer programme is progressing satisfactorily. On August 6 the Squantum plant launched its second destroyer for the United States Navy. Work on destroyers is being handled at the Union Shipyards in San Francisco and at the Fore River plant. The new Squantum yard at Fore River, which cost about $15,000,000, was built and is being operated for the navy by the company. The work done at this plant is considered the greatest accomplishment in naval construction work in the world. We broke ground on this plant in October, 1917, and by October of this year we expect to have delivered the first destroyer, completely fitted out and ready for operation."

Schwab Sends Labor Day Greeting

Director Schwab's Labor Day greeting to the shipbuilders of America carries his characteristic ring of enthusiasm:

"The winning of the war is just as much dependent upon the industrial workers as it is upon the soldiers; one cannot succeed without the co-operation of the other. I believe our workers realize this more and more every day, as the wonderful record of launching nearly 100 ships on Independence Day shows what can be done when we 'put our shoulder to the wheel' under the spur of enthusiasm and are guided by the highest degree of patriotism.

"The shipbuilders are doing a most essential work, which will have great weight toward making the world safe for those who love freedom and the right of self-government.

"Please convey to the workmen my sincerest thanks and appreciation for what they have done, and my absolute confidence in them for what is to come, as I know they will not fail us at this vital time.

"I am devoting all of my time and energy in an endeavor to flood the seas with ships flying the American flag, and with the help of the workers and my friends hope to put the job 'over the top' in good shape."

School for Arc Welding on Ships

A school for the giving of instruction in arc welding has been opened at the plant of the Lincoln Electric Company, Cleveland, under the direction of the Emergency Fleet Corporation. The course of instruction which will be given under experienced men connected with the Lincoln company will be along practical lines, with a view of training the men taking the course for arc welding in shipyards.

First Concrete Bulk-Oil Carrier Launched

On July 27 the first concrete barge—the *Socony 200*—built by the Fougner Concrete Shipbuilding Company, was launched at the company's yard, Flushing Bay, New York City. The vessel is 98 feet long, 32 feet broad by 9 feet 9 inches deep amidships, and 10 feet 3 inches deep at the ends, drawing 3 feet 10 inches light and 9 feet with a cargo of 370 tons.

American Gear Manufacturers' Association Meeting

The semi-annual meeting of the American Gear Manufacturers' Association will be held at the Onondaga Hotel, Syracuse, N. Y., September 19, 20 and 21. Details of the programme will be announced later.

Fig. 1.—Position of Rudders for Going Ahead

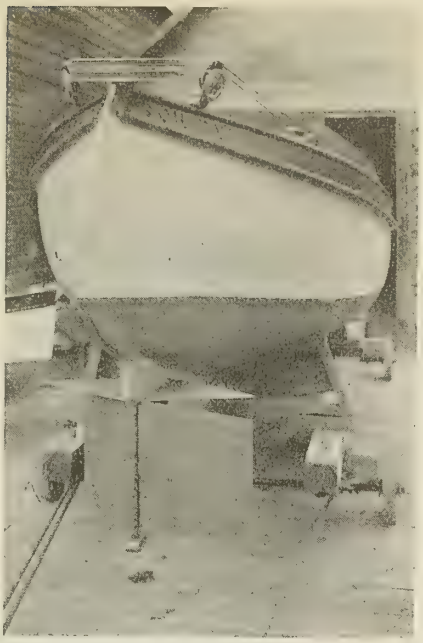


Fig. 2.—Rudders Set for Quick Turning of Boat

Fig. 3.—In This Position the Rudders Will Quickly Reserve the Motion of the Boat

Reversing and Control Rudder

The General Electric Company has recently equipped a 25-foot motor boat, owned by W. B. Landreth, deputy State engineer of New York, with a reversing and control rudder, with a view to showing the possibility of eliminating reversing turbines from turbine propelled ships.

This boat is capable of backing up with the engine running in a forward direction, and of accomplishing the valuable feat of turning around in its own length. With this rudder the boat can be maneuvered without steerageway—that is, with the rudders placed at right angles to the axis of the keel, and with the engine running at full speed, the boat will stand perfectly still; then, by making a slight adjustment of the rudders, the boat will turn around in its own length and continue to do so until the adjustment is changed. During the process of this circular motion the boat can leave for any point of the compass at full speed. As an illustration of the maneuvering qualities of the rudder this boat was run into a 40-foot slip full speed ahead, turned around and brought out bow first without touching either side of slip.

The rudder on the Landreth boat, the invention of H. O. Westendarp, of Boston, consists of two steel plates 3/16 inch thick, each plate the size of the normal rudder used on this type of boat. The rudder post consists of a steel rod within a steel tube. One plate of the rudder is attached to the tube and the other to the rod. The boat is equipped with two steering wheels, arranged side by side, one wheel to operate the rudder affixed to the tube, the other, the rudder fastened to the rod. The manner in which the rudders are affixed to the stern of the boat is best illustrated in Fig. 1. The two rudders are here shown close together in the position for normal cruising, at which time they are used as an ordinary rudder. The two steering wheels are on the same axis, and when locked together operate as one wheel (Fig. 4) for ordinary cruising. But when the boat is to be turned sharply or reversed, the wheels are instantly released, so that they may be revolved in opposite directions to manipulate the rudder plates.

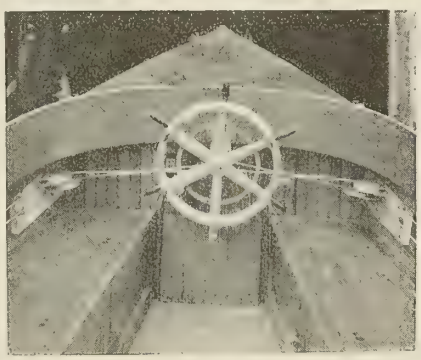


Fig. 4.—Steering Wheels

The ease with which the boat can be made to turn within its own length is remarkable. By placing the rudders in the position indicated in Fig. 2, the boat will turn around in a few seconds and travel back up its own wake. How easily this maneuver is executed is proved by the remarkable photograph reproduced in Fig. 5. This picture of three exposures made on one plate a few seconds apart shows the Landreth motor boat turning in approximately its own length while traveling full speed ahead. The boat made a complete turn in approximately twenty seconds.

With a few turns of the wheels the rudder plates are set in V-shape, as illustrated in Fig. 3. In this position, with

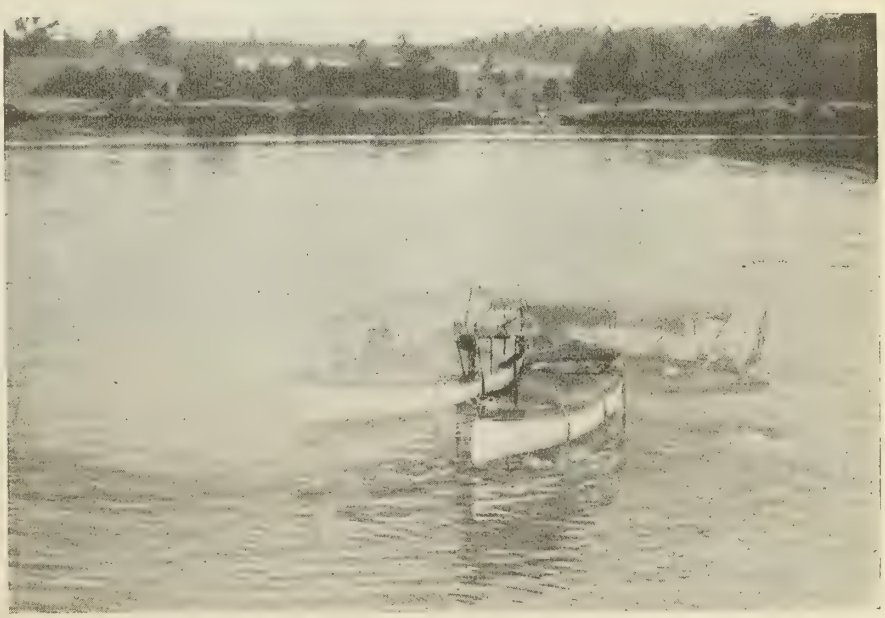


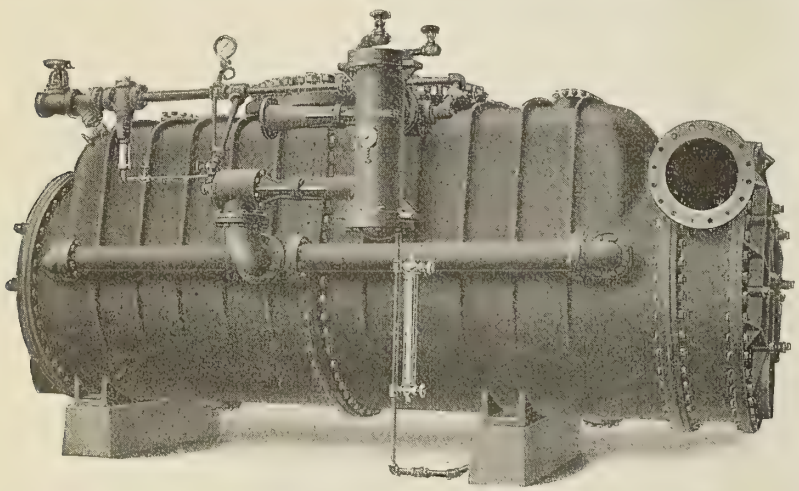
Fig. 5.—Motor Boat Turning in Its Own Length in 20 Seconds

the propeller running full speed ahead, the boat almost instantly stops and starts to run backwards. The boat was brought from full speed forward to backing in nine seconds. With the reversing gear originally installed on this boat it took twenty-six seconds to back. The reversing speed can be controlled to any degree by increasing or decreasing the angular positions of the rudders. The reversing motion is imparted by a stream of water thrown back against the rudder by the propeller and projected thereby forward along the sides of the boat toward the bow. The speed of this water is sufficient to propel the boat backwards at about 30 percent of the full speed ahead. It will be noted that there is a steel plate, or fin, above the rudder which prevents the water thrown back by the propeller from escaping over the top of the rudder. This fin assists in directing the water forward along the sides of the boat. It was discovered by experimentation that the angle of the supporting rod must be 90 degrees or more with the propeller shaft.

Air "Occluders" for Use With Condensers

The successful development of the ejector type of air removal apparatus within the past few years for use in connection with condensing equipment, has been such that it is now recognized by the engineering profession as the best for this purpose. Its light weight, small space occupied and simplicity of operation make it particularly suitable for marine work requiring a high degree of vacuum to be maintained, operating with a minimum amount of steam and freedom from possible breakdowns on account of absence of moving parts.

The aparatus consists of two exhausters arranged in series, with an intercooler of either the surface or yet type placed between them. The first exhauster, known as the primary nozzle, is



Marine Installation of Alberger Air "Occluder" With Surface Intercooler

connected to that part of the equipment from which the air and non-condensible vapors are to be removed, and is so constructed that the impelling steam entrains the air and non-condensible vapors and compresses them to the pressure existing in the intercooler.

The mixture of steam and ejected air and non-condensible vapors are then discharged into the intercooler, which, by condensing the steam and cooling the air and non-condensible vapors, reduces the volume to be handled by the final or secondary exhauster. This in turn reduces the amount of steam required for operating the secondary nozzle, permitting the handling of high ratios of compression, and, as a result, the quantity of steam required by the primary nozzle is relatively small. Without the intercooler the same quantity of air and non-condensible vapors would be handled, but a much larger quantity of steam would be necessary for operating the secondary exhauster.

The quantity of intercooler water required is small, and it can be utilized for boiler feed make up. When used in connection with a surface condenser, provision must be made in the design of the condensate pump to handle the additional amount of cooling water necessary for the operation of a jet intercooler, although this item may be neglected if a surface intercooler is used. The temperature of the intercooler water should be the same as that used for condensing.

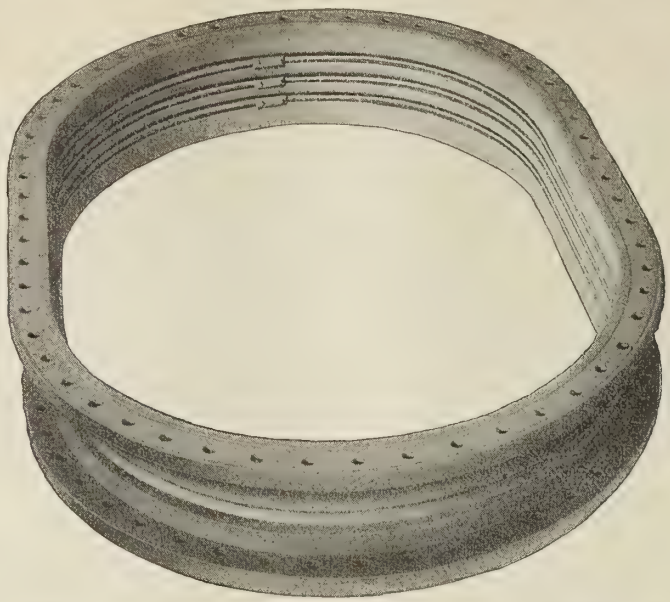
For marine work a surface intercooler is used, as shown on the illustration, permitting the use of sea water in this cooler and avoiding mixing sea water with the steam used by the "occluder."

Each "occluder" is designed to operate under the normal boiler pressures obtaining, but the apparatus is not offered for steam pressures below 140 pounds gage.

Two or more "occluders" may be attached to a single large condenser. This gives the greatest amount of flexibility in operation. For example, when starting up the main unit two "occluders" can be used, permitting a quick start. After the vacuum has been obtained one "occluder" only need be operated, unless there is an excessive amount of air to be handled.

The general arrangement of the "occluder" is well shown by the illustration of the device as well as the illustration showing the connections between the "occluder" and the surface condenser.

This apparatus is manufactured by the Alberger Pump & Condenser Company, 140 Cedar street, New York City.



Corrugated Copper Expansion Joint for Installation Between Low-Pressure Turbine and Condenser

Expansion Joint of Unusual Size

The illustration shows a low-pressure corrugated copper turbine expansion joint manufactured by The Alberger Pump & Condenser Company, New York, measuring inside 7 feet 3 inches by 5 feet, a total pipe area of nearly 31 square feet. This expansion joint, for use between the turbine exhauster flange and the condenser inlet flange, is unusual, both as to the large size and irregular shape.

As will be noted from the illustration, the flanges are very heavy, and reinforcing bars are provided within the corrugations to prevent the joint from collapsing under the influence of vacuum on the inside and air pressure outside of the joint.

The Lone Star Shipbuilding Company, Beaumont, Tex., has received a contract for equipping twenty-two wooden ships, now being built on the Gulf Coast, for the United States Shipping Board.

Westinghouse Brings Out Small Turbo-Generator Unit

To-day it is the duty of everyone to do his utmost in winning the war; and, therefore, no stone should be left unturned in obtaining a greater production with the same number of men, or the same production with fewer men; and no waste in material, time or money

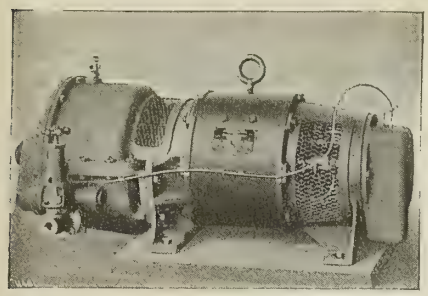


Fig. 1.—Ten-Kilowatt Set Complete

should be permitted. To aid in furthering work in many lines the Westinghouse Electric & Manufacturing Company has recently produced a small turbogenerator unit for direct-current service. This unit is designed for 10 kilowatts output, although a temporary load of approximately 12.5 kilowatts may be obtained. A smaller unit of 8.5 kilowatts gives a range of capacity suitable not only for lighting work, but also for the majority of electric magnet work. Its range of capacity, its range of operating conditions and its construction make this an admirable unit for many uses.

Since the energy developed is direct current, it is finding great favor on steam locomotive cranes, where it is used for lifting magnets. To-day locomotive cranes are in demand as never before; and as many of these cranes are now equipped with electromagnets, this unit enables the purchaser and the user of these locomotive cranes to have all the advantages of the electric locomotive crane in handling scrap and pig iron. It is needless to say that to-day, with the scarcity of labor, any labor-saving device in handling raw material in yards and factories is of high importance in getting out larger production. Its simple, rugged and reliable construction enables it to be used at great distances from machine or repair shops, as there are no reciprocating parts to wear out, and as practically the only attention which it requires is to have its oil well filled occasionally.

In building this 10-kilowatt set the manufacturer has recognized that it must operate under the most trying conditions. For that reason it is as simply constructed as possible, while yet having many of the features found desirable in larger units. Among these is a hand and automatic throttle valve and an emergency over-speed governor. This latter feature is placed on the generator end of the unit and automatically closes the throttle valve of the turbine, if the unit should show a disposition to overspeed. The device consists of a small weight placed in the shaft of the unit, which, at a predetermined speed, engages a trip lever, connected in such a way to the throttle valve that it is automatically closed, thus stopping the unit.

The most important feature of this unit is that it has but one revolving element in which the generator shaft is extended so that it also carries the turbine rotor. This not only makes a very compact machine, but eliminates all coupling and misalinement troubles, and dispenses with turbine bearings and packing.

The turbine rotor is made of a high-grade open-hearth steel forging, accurately finished, in the periphery of which are placed blades of electric furnace steel, which are held in place by pins tightly driven in through blade and rotor. The blades are of the impulse type, and although there is only one row of blades, yet, by means of a reversing chamber, the same steam is passed through the blades a second time, thus allowing complete expansion of the steam.

Since the unit is designed to occupy the least possible space, the manufacturer has equipped the generator with ball bearings (no bearings being required on the turbine) instead of the usual type of surface bearing; thus saving in bearing friction, while consequent decrease in length and weight of the unit is effected. Moreover, these self-alining ball bearings on small units are suited for a variety of services, particularly for marine work, which oftentimes compels the unit to operate at an angle, due to the position of the ship.

As is shown in the illustration, all open places on the unit have been cov-

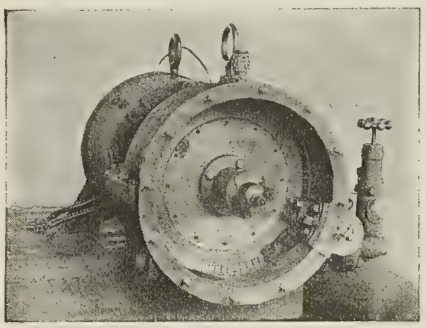
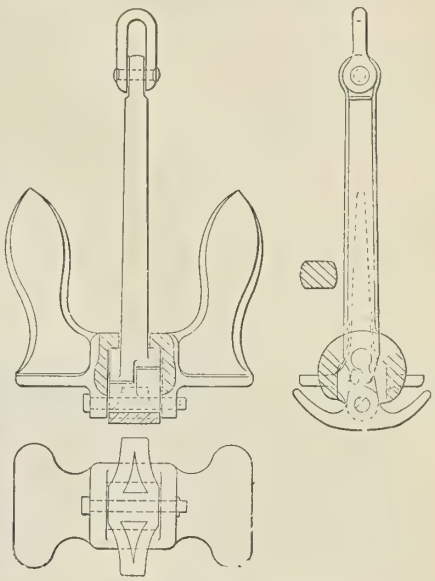


Fig. 2.—Set With Turbine Cover Removed

ered with pieces of expanded metal, which protects not only the operation but also the generator parts from incoming foreign matter. Its compactness (the unit is only 3 feet 8½ inches long, 23 inches wide and 18¾ inches high), together with its lightness, enable it to be used where space is valuable or for portable work.

New Ryan Stockless Anchor

Until the present more or less fault has always been found with the various types of stockless anchors on the market. Naval architects have deplored the fact that anchors would invariably drag for a considerable distance before taking hold, or would foul or roll over on a sandy bottom. To meet this need an improved type of anchor has been devised by Patrick J. Ryan, of 30 Church street, New York City, at the instigation of one of the naval architects connected with a large shipbuilding plant in the South. Well known as a former joint owner of the Baldt Anchor Works in conjunction with the elder Frederick Baldt, of Chester, and intimately in touch with the needs of the service as representative of various steel casting concerns during the last twenty-five years—for the past five years Eastern representative of the Hammond Steel Company and the Detroit Steel Company—Mr. Ryan may be considered an authority on the subject and quite competent to design a model which meets with all the requirements of the United States Navy specifications and the ap-



Ryan Stockless Anchor

proval of the American Bureau of Shipping.

Construction of the New Anchor

In working out the problem Mr. Ryan hit upon the idea of utilizing the trip piece on the back of the crown. The accompanying illustration shows the trip piece in position to take hold the moment it is grounded. The shank has staggered teeth, which move in conjunction with the staggered teeth on the trip piece, each operating in an opposite direction. The head is practically closed when in operation, consequently mud or stones cannot accumulate in the mechanism. Most of the other anchors on the market have open heads. In the latter type if a pin or stone should become lodged or jammed under the shank it would prevent the free action of the flukes. Since the pin forms the seat of the shank the flukes would still operate were the trip piece to become broken.

Special Features

Due to the special construction of the anchor it is claimed that it takes hold the moment it is grounded. The side flanges take hold simultaneously with the flukes, and the more pulling strain put upon the shank the deeper the flukes sink into the mud. This result is assured by the downward inclination of the flukes, the exact pitch of which has been carefully calculated from a scientific standpoint. The only way to release this anchor is by heaving to. The anchor can never foul or roll over, it is claimed. A core is provided in the back of the trip which allows the free transmission of water. The strain on the head is equally distributed throughout the entire portion of the crown piece with strengthened fillets, insuring perfect solidity of metal.

Letters patent have already been applied for in all foreign countries as well as in the United States. It is claimed that no machine work is required upon the new Ryan stockless anchor, which reduces production costs to a minimum. Specifications provide for the making of this anchor in all sizes. Since a company is now being formed to manufacture the new Ryan stockless anchors according to the United States Navy specifications, active operations will doubtless be undertaken during the coming month.

Air Planers Save Labor and Speed Up Wooden Shipbuilding

In a contest conducted last April, at the Foundation Company's shipyard at Portland, Ore., the workman shown in the photograph reproduced on this page planed 385 square feet of a wooden vessel's side in five hours, while eight men, with hand tools, finished only 275 square feet of surface in seven hours. The pneumatic tool used in this contest was an air planer, Model C, manufactured by the Shipbuilders Pneumatic Tool Company, Portland, Ore. It is operated by compressed air turbines attached at each end of the planer head and mounted on ball bearings in a frame. The planer head is made of phosphor bronze and has two knives.

Surfacing a Ship's Side With Compressed Air Planer

The planer operates at a speed of eight thousand revolutions per minute and, it is claimed, gives a perfect surface over treenails, knots, calking, marine glue and pitch pockets. It weighs only ten pounds and has practically no limitations in edging, planing, adzing and surfacing of wood. Being a portable tool, it saves carrying heavy timbers to a stationary machine for dressing and it can be taken to the work on the vessel without any delays in lining up the work. Therefore its use results in saving both time and labor and speeding up production in the shipyard.

PERSONAL

W. T. Smith has been elected president of the Chester Shipbuilding Company, Chester, Pa.

L. T. Kniskern, superintendent of construction of the Chester Shipbuilding Company, Chester, Pa., has been appointed general manager of the company.

Dr. C. W. Doten has been appointed executive head of the industrial service section of the industrial relations group of the Emergency Fleet Corporation, vice Meyer Bloomfield, who has been named advisory counselor of industrial service and employment.

G. A. Tomlinson, general manager of the New York Canal section of the United States Railroad Administration, has been appointed Federal manager of New York and New Jersey canals.

John G. Pew, formerly president of the Peoples Natural Gas Company, and the Home Natural Gas Company, Pittsburgh, Pa., has been elected vice-president and general manager of the Sun Shipbuilding Company, Chester, Pa.

Benjamin P. Young, formerly of Young, Rakestraw & Ferguson, naval architects, Philadelphia, has opened an office as naval architect and ship and engine surveyor, at 1711 Diamond street, Philadelphia. Mr. Young has severed his connection with Cox & Stevens, naval architects, New York.

F. W. Ballard has been appointed power specialist, attached to the office of the vice-president in charge of construction of the Emergency Fleet Corporation.

Alex. Maitland has been appointed district supervisor in the Division of Wood Ship Construction of the Emergency Fleet Corporation, Sixth District, with headquarters in the Carter Building, Houston, Tex., succeeding Charles N. Crowell, assigned to other duties.

Fred A. Ballin, formerly secretary and treasurer of the Supple-Ballin Shipbuilding Corporation, Portland, Ore., has been elected president of the corporation, succeeding Joseph Supple, retired.

E. C. Kerrigan was appointed general purchasing agent of the Great Lakes Engineering Works, Detroit, Mich., on August 5, succeeding James S. Keightly, resigned.

E. P. Dillon, manager of power division, New York office, Westinghouse Electric & Manufacturing Company, has resigned to become general manager of the Research Corporation of New York.

David Hollywood, formerly general manager of the Ames Shipbuilding Company, Seattle, Wash., has been appointed works manager of the South Western Shipbuilding Company, San Pedro, Cal.

F. H. Charbono, for many years representing the Independent Pneumatic Tool Company in the East, has been appointed manager of the Southern district of the company, with headquarters at 1721 Jefferson Company Bank Building, Birmingham, Ala., succeeding George C. Wilson, resigned.

E. W. Swartwout has been appointed manager of the Philadelphia office of the Nordberg Manufacturing Company, Milwaukee, Wis., with the special duties of serving the company's interests with the various departments of the Emergency Fleet Corporation in Philadelphia and the various technical departments of the government in Washington.

Henry Lysholm, general manager of the New Jersey and Pennsylvania Shipbuilding Companies, Gloucester, N. J., has been elected vice-president of the Pusey & Jones Company, Wilmington, Del.

M. E. Davis, superintendent of the New Jersey Shipbuilding Company, has been elected general manager of the combined plants of the New Jersey and Pennsylvania Shipbuilding Companies, Gloucester, N. J. It is understood that Hugh V. Ramsey, superintendent of the Pennsylvania yard, will be made general superintendent, of the two plants.

Albert W. Murray, assistant superintendent, Morse Dry Dock & Repair Company, Brooklyn, N. Y., has been promoted to the position of superintendent of the company, vice E. P. Morse, Jr., resigned.

OBITUARY

George W. Dickie, one of the leading naval architects in the United States and a vice-president of the Society of Naval Architects and Marine Engineers, died August 16, aged 74.